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RADC-TR-78-127
Final Technical Report
June 1978

16 KILOBIT MODEM EVALUATION

Frank A. Perkins
Daniel D. McRae

Harris Corporation

F30602-76-C-0460

ADB029131

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RADC-TR-78-127 has been reviewed and is approved for publication.

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RADC Project Engineer: Capt Joseph E. Laposa (DCLD)

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Key Generator Tests	Modem Algorithms	
Envelope Delay	Telephone Modems	
Amplitude Variation	Secure Voice	
Phase Jitter	16 KB/S Modem	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The primary objective of this program was to perform extensive testing of the 16 kb/s modem on the AUTOVON network to establish the adequacy of the modem design. The goal was to provide good voice quality over the Network when used with 16 kb/s CVSD's. The modem was tested in Europe, the Pacific, on Trans-Atlantic and Trans-Pacific Networks and on some CONUS lines.

Test results were very encouraging and provide a high level of confidence that the modem design is sufficient to provide good voice quality over the

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existing AUTOVON Network as well as over planned network improvements.

In addition to excellent error rate performance, the modem demonstrated an extremely high probability of synchronization, even under very adverse conditions. The modem was able to achieve synchronization on all tested lines and considering all calls and all conditions, including extreme burst phenomena, the average synchronization probability was 96.4 percent.

Compared to presently operational 9.6 kb/s modems, the 16 kb/s modem using the same CVSD (Hy-11) provided essentially identical voice quality with error rates up to 3-5 percent as did the 9.6 kb/s system operating error free.

Only two classes of disturbances were found to significantly affect modem performance. These were harmonic distortion and fading associated with tropo links. Harmonic distortion is significant only in CONUS. Here the use of D conditioned lines, rather than existing C-3 conditioning will specify harmonic distortion to a satisfactory level. Tropo fades are significant only on European lines. For this application a good probability exists that additional or modified modem algorithms will provide significant immunity to fades. Even though the modem was found most sensitive to distortion and fading, the performance was satisfactory even on links exhibiting these characteristics.

Limited tests performed on existing digital links associated with the FKV project indicate that a high probability exists that the modem performance will not be degraded by the eventual digitization of the network.

A short HF link was tested in the Pacific resulting in adequate performance. However, the link was short and is not a true representation of HF phenomena on long links. The results, although not conclusive are encouraging.

Subsidiary program objectives included measurement of line parameters and characteristics and performance of interface tests with standard key generators to establish the level of synchronization loss relative to modem bit error rate. All of these objectives were accomplished.

Several logical recommendations regarding the 16 kb/s modem can be made. Research, Development, Test and Evaluation (RDT&E) units should be procured to provide a larger sample of modems for additional test as well as for user evaluation. Additional investigation should take place to determine modem algorithms which will improve performance in the presence of fades and high levels of harmonic distortion. Additional testing should be performed over HF simulators and active HF links to characterize modem performance as well as provide insight into additional algorithms that may provide enhanced performance.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

TABLES

TABLES (Continued)

ILLUSTRATIONS

ILLUSTRATIONS (Continued)

ILLUSTRATIONS (Continued)

ILLUSTRATIONS (Continued)

ILLUSTRATIONS (Continued)

EVALUATION

The Department of Defense requirement for an improved, inexpensive, end-to-end secure voice communications system using the existing analog AUTOVON Network has fostered the investigation of various secure voice transmission approaches. One such approach being considered is the 16 KBPS Continuously Variable-Slope Delta Modulation (CVSD) Digital Voice Technique which offers much improved speaker recognition and voice intelligibility as compared to that obtained with slower data rate digital voice systems presently available. This technique and moreover the use of existing narrowband (4kHz) voice channels of the AUTOVON Network have created the need for a 16 KB/S Modem.

Under a previous CY-75 program, practical 16 KBPS Modem techniques were developed to provide satisfactory voice quality with 16 KBPS CVSD on a large percentage of dialed-up calls on the AUTOVON Network. The 16 Kilobit Modem Evaluation Program is responsible for providing the first in-depth step in determining the adequacy of the 16 KBPS Modem design. Reliable modem operation was obtained over AUTOVON facilities in the CONUS, Europe and the Pacific, as well as over Transoceanic (satellite and subcable) transmission links.

Additional work will continue in this area to further evaluate the performance of the modem over the existing CONUS AUTOVON and commercial telephone networks. In addition, an Advanced Solid State Study will investigate the possible use of state-of-art microprocessor technology in implementing the successful 16 KBPS Modem design in future production versions. A follow-on 16 KBPS Modem Development Program, to be conducted in FY 78-79 time frame, will further refine the modem design with the objective of achieving operational hardware.

Joseph E Laposa

JOSEPH E. LAPOSA, Capt, USAF
Project Engineer

1.0 INTRODUCTION AND BACKGROUND

1.1 Prior Study Activity

In February 1975 Harris Corporation was awarded a contract (F30602-75-C-0129) from the Rome Air Development Center (RADC) to study approaches available for developing a 16 kb/s modem capable of providing adequate voice quality over the AUTOVON network when operated with 16 kb/s continuously variable slope delta modulator (CVSD). The principal outcome of that study activity was a breadboard modem which was subsequently tested on a number of CONUS AUTOVON circuits from RADC with encouraging results.

The results of the study activities, as well as the test results are provided in the study final report.[1]

1.2 Objectives

Because of the favorable outcome of the first study program, RADC initiated a follow-on activity (Contract No. F30602-76-C-0460) with the following objectives:

a. Repackage the breadboard modem to make it suitable for transporting overseas for testing.

b. Modify selected modem algorithms to allow selection of optimum final design approaches during Overseas (OCONUS) testing.

c. Plan and conduct tests on the Overseas Autovon network to determine the optimum approaches.

d. Conduct interface tests with several standard key generators (KG's) to establish the level of synchronization loss relative to the modem bit error rate (BER).

1.3 General Outline

In this report consideration has been made first to the line test results and secondly, the supporting items such as design changes incorporated in the modem prior to testing and KG interface tests. Section 2.0 presents the results of the test program. Section 3.0 describes the various approaches which were tested and discusses other modifications made to the modem during the course of the program. Section 4.0 discusses the KG interface tests and Section 5.0 presents conclusions and recommendations. The Appendices contain the detail test data and supporting information.

2.0 TEST PHASE

Since a major objective of the test phase was to establish the adequacy of the design approach, the first step in planning the tests was a determination of the potential applications for the modem in the OCONUS network. Considerable effort was devoted to reviewing future plans for the digital network, and determining potential modem applications. A review of the findings of this effort are provided in Appendix A. Three categories of potential use are:

a. Upgrading the voice quality compared to that presently available from the existing 2.4 kb/s vocoders and the 9.6 kb/s CVSD units in present use in the AUTOSEVOCOM network. This implies that the modem signal is treated as analog by all of the switches in the network independent of whether or not specific trunks may have been digitized.

b. Interfacing subscriber locations which do not have digital service with the digital network. This implies that the modem signal is treated as an analog signal only on the access lines connecting the subscriber to the digital switch, and at that point is converted to a

digital signal for transmission over the digital network. This presupposes the existence of digital switches as well as digital trunks.

c. Handling 16 kb/s digital traffic over interswitch trunks which either cannot be digitized or which will not be digitized in the earlier phases of the digital conversion. Specific examples of this are undersea cables and other leased Telpak service. However, it would appear that on an interim basis, interswitch trunks requiring tropo hops and commercial satellite links also fall in this category. In this case, several links may be in tandem and the error rates of the individual links will add.

It is apparent that the first category of use is the most demanding on modem performance since it requires operation of the modem over all segments of the network. However, testing which allowed conclusions to be drawn concerning the last two categories individually appeared prudent since inadequate modem performance for the first category would not necessarily imply inadequacy for the last two categories.

The remainder of this section presents material associated with testing. Paragraph 2.1 discusses the method of testing and other subjects necessary to understand and interpret the test results. Modem performance data obtained from all of the different test areas is provided in Paragraph 2.2. Paragraph 2.3 provides the line measurement data obtained in the test program. Paragraph 2.4 discusses the test procedures used to obtain these results. The comparative error rates obtained in the different modem modes that were tested are presented in Paragraph 2.5.

2.1 Test Philosophy

Before presenting the test results several items need to be presented so that the results can be understood and properly interpreted. This section discusses the range of CVSD error rates necessary to provide adequate voice quality, the nature and types of tests conducted and a brief review of the AUTOVON network.

The objective of the test program was to establish the best modem design approach and to evaluate the adequacy of that approach in the network. The "adequacy" in this case means the adequacy of the voice quality available from the modem in conjunction with an appropriate 16 kb/s CVSD unit. The adequacy of the modem from the standpoint of operational features and maintainability was not evaluated at this time since only an advanced breadboard unit was used in the test program.

The CVSD unit used during the tests was the HY-11 which is presently being used in the network for the 9.6 kb/s service. Voice recordings as well as BER measurements were made on the majority of calls. Although the voice recordings are quite interesting, in virtually all cases the general quality of the voice is quite predictable from the BER numbers. If the listener is listening to the conversation rather than specifically listening to the background noise he will likely not notice the noise increase due to the modem until the BER exceeds 10^{-2} or 1%. At 2% the noise is noticeable but does not impair the conversation. At a BER of 5% the noise is objectionable but a reliable conversation can easily be held. At a BER of 10% abbreviated communications are possible, such as a request to hang up and call back on another line, but in general, the quality is unsatisfactory. Based upon the subjective judgment of the test teams, the quality of the voice provided by the HY-11 operating at 9.6 kb/s error free is approximately equivalent to that provided by the HY-11 at 16 kb/s operating with an error rate between 3% and 5%.

The approach taken in planning the modem tests was to attempt to maximize the number of locations and routings involved with the calls. Seven test sites were selected, three in Europe, three in the U.S. and one in the Pacific. The three European sites were: Hillingdon, England; Feldberg, Germany; and Coltano, Italy. The Pacific site was Pearl Harbor on Oahu, Hawaii. The three U.S. sites utilized were: Ft. Dietrich, Maryland; Stockton, California; and Melbourne, Florida.

A combination of one way calls and loop around calls were used. Since the advanced breadboard modem from the original study contract contained only one

transmitter and one receiver, a second transmitter was constructed for the tests. The bulk of the calls were planned to be loop-around calls conducted from the site of the modem. In addition to these calls a number of one-way calls were planned from the transmitter site to the modem site. On these calls the parameters were measured for both one-way calls and looped calls on the same line so that estimates might be made as to the probable performance of normal one-way calls on the lines measured by the loop-around technique.

The results given in Paragraph 2.2.1 indicate that the error rates achieved on loop-around calls were substantially worse than those obtained on one-way calls on the same lines. Therefore, to fairly interpret the loop-around results it is necessary to recognize that substantial improvement should exist if the same two locations were involved in a normal one-way call.

The tests were divided into the following five segments:

a) European network tests

b) Tests from Europe to CONUS or Trans-Atlantic tests

c) Pacific network tests

d) Tests from Hawaii to CONUS or Trans-Pacific tests

e) CONUS network tests

As discussed in Appendix A the AUTOVON system can be thought of as four networks connected together. The European network has ten AUTOVON switches that supply telephone service to over 100 subscriber locations. The Pacific network has four AUTOVON switches which serve a smaller number of subscriber locations. The Caribbean network has only one switch which serves a relatively small number of subscriber locations. The CONUS network has 70 switches serving a large number of subscriber locations. The four networks making up the AUTOVON system are interconnected via "gateway switches."

There are three gateway switches in Europe that connect to two CONUS gateway switches. Similarly the Pacific network has three gateway switches which connect to two different CONUS gateway switches.

Within one of the networks it is convenient to think in terms of two categories of trunks and channels. These are those that connect the switches together (interswitch trunks, or IST's), and those that connect a subscriber location to a switch (access lines). In the European network testing, four varieties of calls were made. These were:

a) IST loop-around calls

b) IST one-way calls

c) Access line loop-around calls

d) Remote access line loop-around calls

The remote access line calls were calls to a subscriber of a switch other than the switch where the modem was located. Thus the calls involved both IST and access lines. The calls in the Pacific network were limited to IST loops and remote access loops. Since only one Pacific site was used, no one-way tests were conducted. The Pacific calls all involved an access line from Pearl Harbor to the switch at Wahiawa in addition to the IST's and remote access lines where these were involved. However, the access line to Wahiawa was extremely good so that the performance should not be significantly affected by it. Access lines from the Wahiawa switch were not tested because it was felt that the data obtained from remote access calls would be of greater interest. Hence, calls involving access lines off other switches were selected instead.

The trans-Atlantic calls were conducted from Hillingdon, England, one of the gateway switches, to Ft. Dietrich, Maryland. The trans-Pacific calls were conducted from Pearl Harbor, Hawaii to Stockton, California. Both one-way and looped calls were

made on these connections. The CONUS calls were all loop-around calls from Melbourne, Florida to various CONUS switches. These have been categorized as IST loops since it is felt that the access lines from Melbourne to the switch at Polk City, Florida are not likely to adversely affect modem performance.

The AUTOVON network contains lines with different quality specifications. On interswitch circuits outside of CONUS, these lines are either V2 or S3 (voice grade or data grade) conditioned. On a normal dialed call, the AUTOVON switch will first try the voice grade lines, and if they are busy, it will then try the data grade lines. By dialing a special prefix the switch will try only data grade lines. All of the access lines to normal PBX exchanges in Europe are voice grade. All of the access lines to AUTOSEVOCOM subscribers are data grade. The AUTOSEVOCOM network is presently designed to utilize data grade lines only.

Most of the calls placed during the modem tests were placed without dialing the data prefix. The majority of loop-around calls to access locations were placed to PBX locations and hence were voice grade lines. Thus the data obtained should be representative of that available when the modem is used on the voice grade lines as well as on the data grade lines.

The modem was tested in four different modes. A comparison of performance in these modes is given in Paragraph 2.5. All of the data presented in the Paragraph 2.2 applies to operation in the "standard mode." A description of the modes is given in Paragraph 3.5.

A detailed schedule for all of the testing, except CONUS, is given in Appendix B. The CONUS tests were conducted from the Harris ESD facility in Melbourne, Florida subsequent to the other tests.

2.2 Modem Test Results

This section is subdivided into five parts. The primary test results are presented in Paragraph 2.2.1. Paragraph 2.2.2 discusses the degree of network coverage which was achieved in the testing. Paragraph 2.2.3 provides data as an aid to correlating the difference between one-way and looped calls. Paragraph 2.2.4 discusses interpretation of the basic modem performance data if calls from one network to another were involved. Paragraph 2.2.5 discusses results obtained in "special calls" which did not fall into any of the categories of calls presented in Paragraph 2.2.1.

2.2.1 Test Results

This section presents summarized results of the error rate data given in the tables of Appendix C, which give a complete listing of all measurements taken on each call. Perhaps the best overall summary of the 16 kb modem test results is given in Table 2.2.1-1. As can be seen, a total of 334 calls are included in the nine categories listed. The percentage of calls with bit error rate equal to or better than 1 percent, 2 percent and 5 percent are given. As previously explained, these error rates correspond to good, fair, and poor voice quality when taking the CVSD's into consideration. The quality of the 16 kb voice at 5 percent, however, is not much worse than that of 9.6 kb CVSD voice error free. In the categories involving loop-around calls, both the line percentiles corresponding to the actual error rates and those corresponding to the predicted one-way error rates are given. The conversion is that of the conservative curve given in Figure 2.2.3.

In addition to the BER data given, the total number of syncs and the number of sync successes for each category of line test is given. It should be noted that the probability of obtaining successful synchronization (sync) was better than 50 percent on each of the individual calls and was 96.4 percent averaged over all calls. Thus, there were no lines tested where sync could not be achieved. However, a number of lines in European tests had burst phenomena that caused a missed sync to occur during the test. The normal line test involved several syncs per call.

Approximately half of the sync misses occurring in the European tests occurred within the 2 days preceding the detection of an equipment malfunction which caused unreliable synchronization. This malfunction involved a logic circuit that produced excessive delay when cold. The problem was eliminated when the defective circuit was located and replaced. Since it was not possible to separate the sync misses due to this cause and those legitimately due to line characteristics, all sync misses have been included in the table. In any case, fades in the signal on calls involving tropo

Table 2.2.1-1. Summary of 16 kb Test Results

Type of Call	No. of Calls	Median BER	% of Looped Calls with BER ≤ 5%	2%	1%	% of One-Way Calls with BER ≤ 5%	2%	1%	Synchronization Performance Tries	Successes	%
European IST Loops	85	1.03E-3	92	80	70	100	98	96	346	330	95.4
Pacific IST Loops	25	4.50E-4	100	99	97	100	100	100	93	93	100
CONUS IST Loops	78	4.70E-3	100	85	80	100	100	100	234	234	100
European IST One-Way	21	5.40E-4	-	-	-	100	96	90	91	87	95.6
Trans-Atlantic One-Way	32	4.00E-3	-	-	-	100	92	75	161	161	100
Trans-Pacific One-Way	24	1.18E-4	-	-	-	100	100	99	109	109	100
European Access Loops	34	3.80E-5	100	99	97	100	100	100	151	139	92.1
European Remote Access Loops	26	1.03E-2	85	66	46	95	93	88	118	102	86.4
Pacific Remote Access Loops	9	3.80E-3	89	73	67	100	100	100	27	27	100
Totals	334								1330	1282	96.4

transmission were still a significant cause of sync misses. Even so, the percentage of successful syncs is quite reasonable, especially where degradation of loop-around calls is considered.

Loop-around data, as well as one-way data, was taken on most of the trans-Atlantic and trans-Pacific calls. This data is presented in Tables C.5 and C.6 of Appendix C but was not reduced for presentation in this section since all of these looped calls had corresponding one-way calls and hence are of no value in improving the prediction of one-way performance of trans-Atlantic and trans-Pacific calls. They have been used, however, to compare one-way versus looped performance in general, and are tabulated in Tables 2.2.3-2 and 2.2.3-3 of Paragraph 2.2.3. The looped data on the trans-Pacific calls was generally similar to looped performance of European calls but the looped data on trans-Atlantic calls was considerably worse. This appeared to be due to the high levels of harmonic distortion present in the one-way trans-Atlantic calls which was nearly doubled for looped calls. Although the looped trans-Atlantic performance was generally unsatisfactory, the actual one-way performance on the same lines was acceptable.

Table 2.2.1-2 presents a summary of the 8 kb test results. No attempt has been made to convert looped performance to one-way performance for the 8 kb test. As will be discussed in more detail later, the block throughput figures are the percentage of 8000-bit blocks that were transmitted error free.

Figures 2.2.1-1 through 2.2.1-3 show the percent of the lines which provided performance equal to or better than a specified bit error rate. The curves are for the IST loop-around calls for the European, Pacific and CONUS network, respectively. Included on the curves is the same information for 8 kb tests that were conducted on the same lines used for the 16 kb tests. These curves present the error rates as measured directly on the loop-around calls and do not have a loop-around to one-way conversion factor applied. The 16 kb error rates were obtained by recording the first five 10-second error counts following completion of modem training. In some cases, burst phenomena, such as dropouts, occurred in only one of the five counts. In calculating the error rates shown in the curves of this section, the error caused by these anomalies has been included

although there is same argument that the error rate which determines voice quality should not include errors of this nature. In cases where comparison of performance is involved, such as the comparison of error rates for the different modem modes and comparison of one-way versus looped performance, these anomalous counts have been omitted since they do not bear on the relative performance of the techniques being investigated.

The 8 kb error rates were obtained by recording the errors in the first 100 1-second periods following modem training. These error counts were used to calculate both 8 kb BER and block throughput. The block throughput is defined as the percent of 1 second counts that contained no errors. Thus a "block" of data for the purposes of this test was defined as 8000 bits. This produces a lower block throughput number than would exist for a smaller block length. This should be taken into account in any comparison of results. In all cases, anomolous counts in the 8 kb measurements were included in calculating both BER and block throughput.

Table 2.2.1-2. Summary of 8 kb Test Results

Type of Call	Percent of Calls With BER ≤ 10^{-4}	Percent of Calls With BER ≤ 10^{-5}	Median BER	Median Block Throughput
European IST Loops	79%	47%	1.5×10^{-5}	99.3
Pacific IST Loops	94%	92%	$< 10^{-5}$	100
CONUS IST Loops	99%	89%	$< 10^{-5}$	100
European IST One-Way	83%	55%	$< 10^{-5}$	95.5
Trans-Atlantic One-Way	97%	76%	$< 10^{-5}$	100
Trans-Pacific One-Way	96%	84%	$< 10^{-5}$	100
European Access Loops	94%	83%	$< 10^{-5}$	100
European Remote Access Loops	59%	35%	5.2×10^{-5}	96.6
Pacific Remote Access Loops	83%	73%	$< 10^{-5}$	100

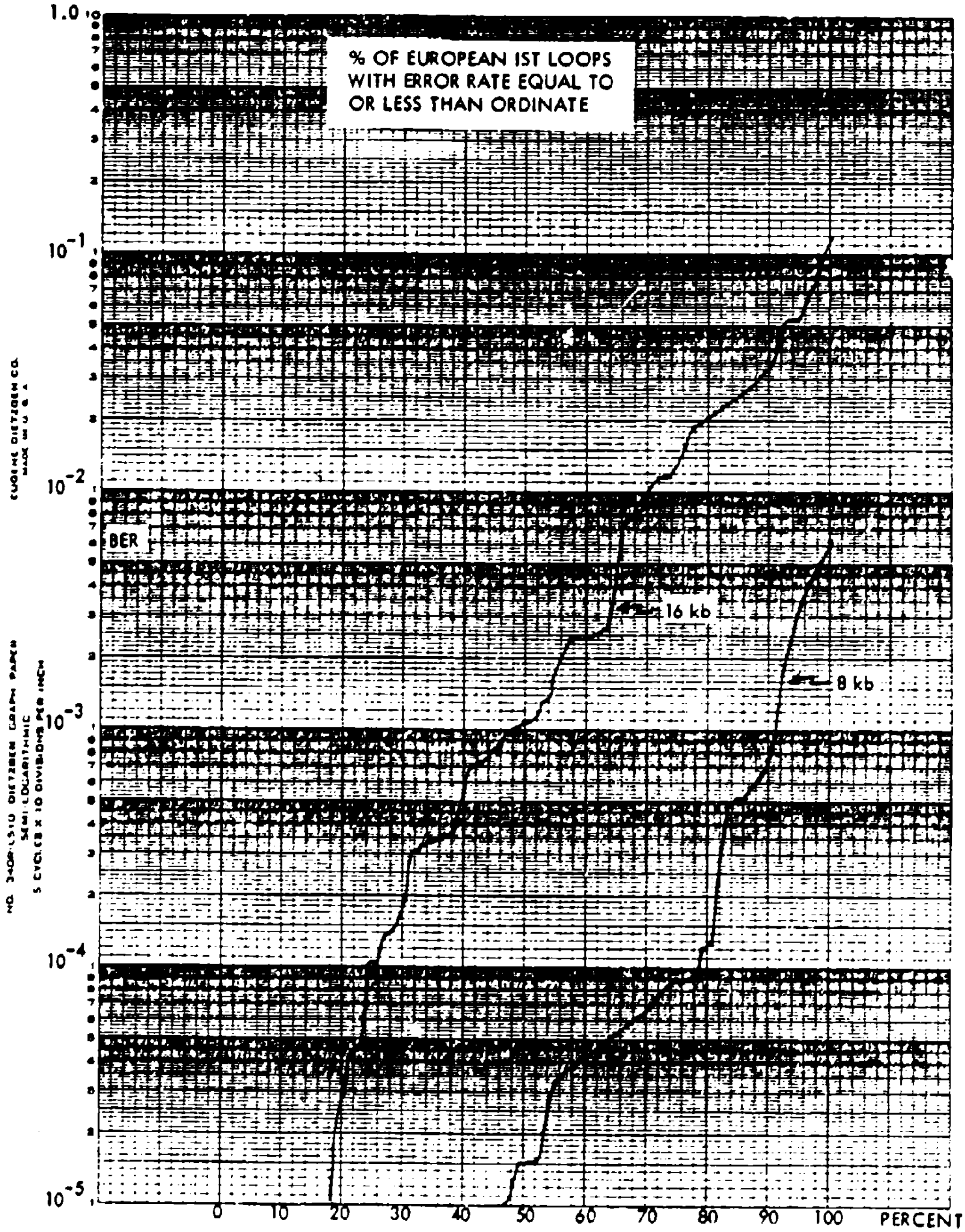
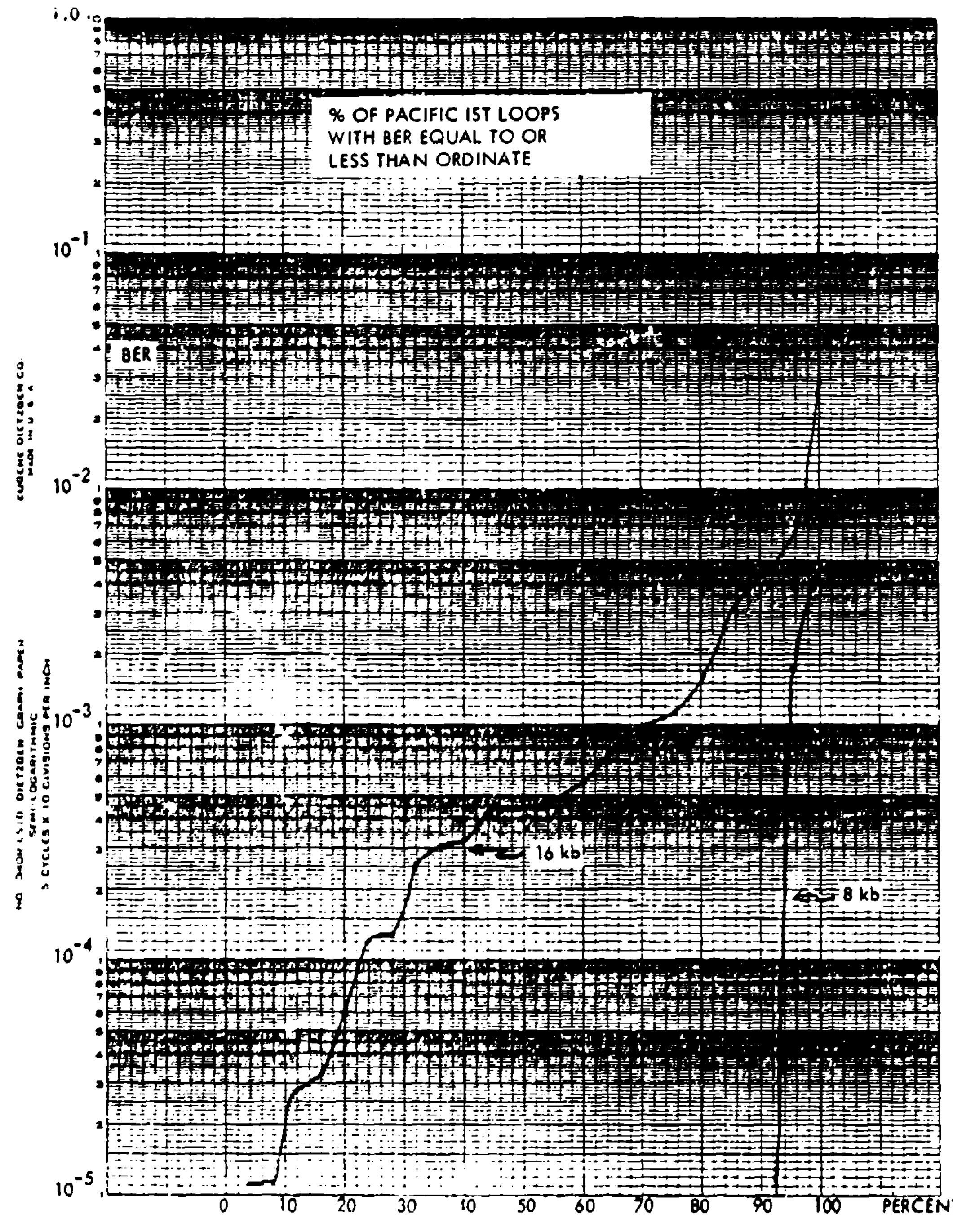

% OF EUROPEAN IST LOOPS
WITH ERROR RATE EQUAL TO
OR LESS THAN ORDINATE
1.0
10^-1
10^-2
10^-3
10^-4
10^-5
BER
16 kb
8 kb
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-1



1.0
10^-1
10^-2
10^-3
10^-4
10^-5
% OF PACIFIC IST LOOPS
WITH BER EQUAL TO OR
LESS THAN ORDINATE
BER
16 kb
8 kb
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-2

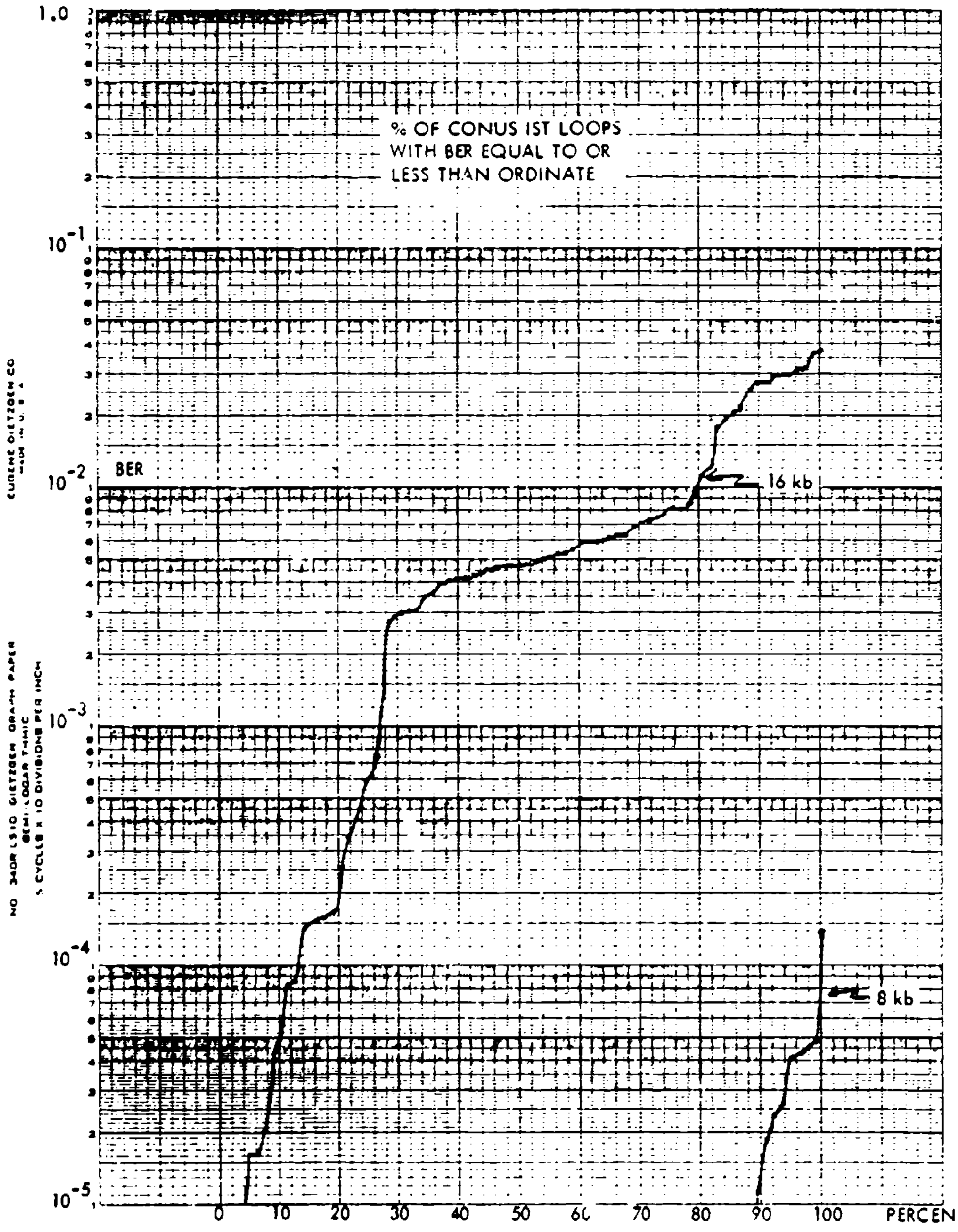

% OF CONUS IST LOOPS
WITH BER EQUAL TO OR
LESS THAN ORDINATE
BER
16 kb
8 kb
1.0
10-1
10-2
10-3
10-4
10-5
0
10
20
30
40
50
60
70
80
90
100
PERCENT

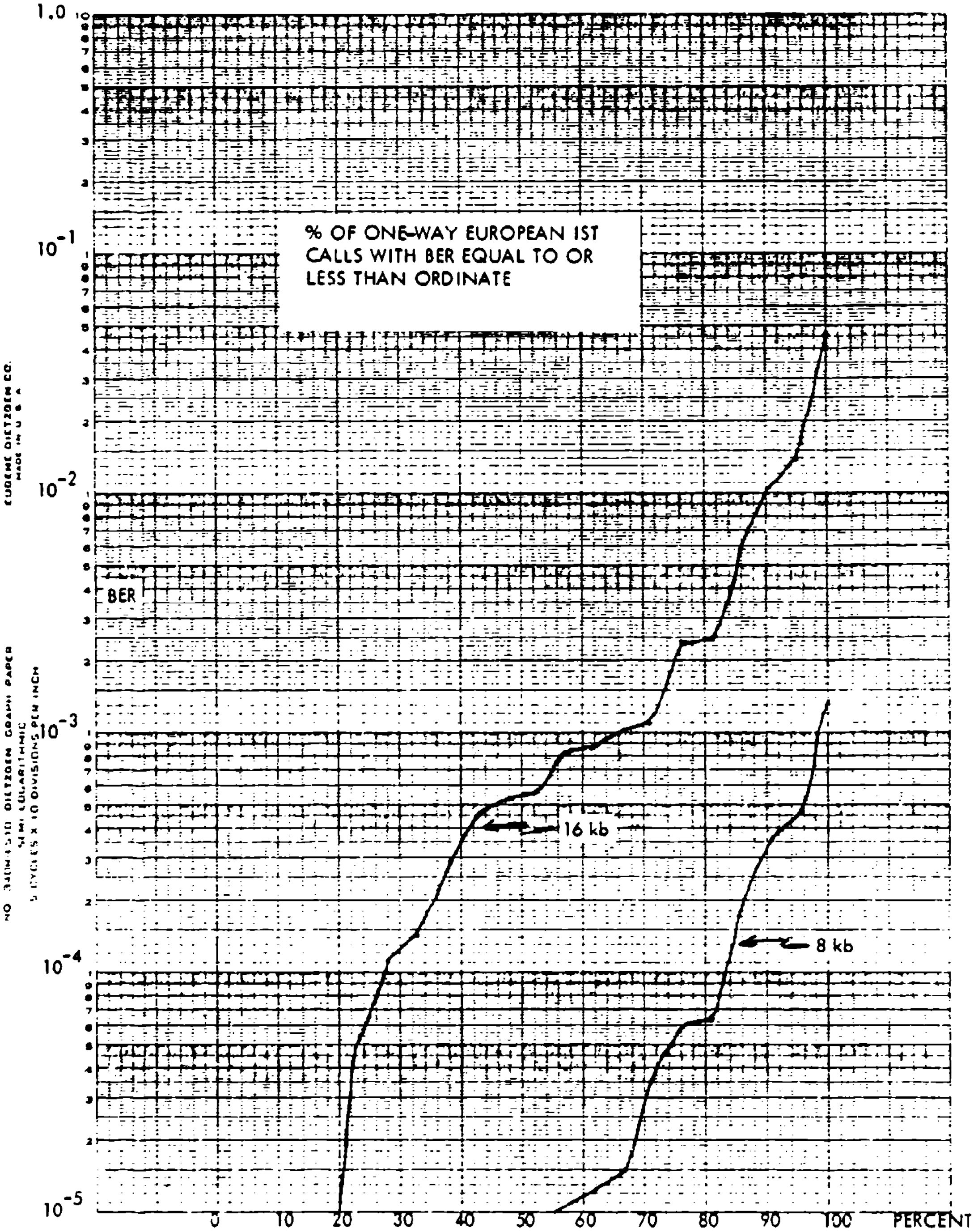
Figure 2.2.1-3

The performance curves for the three networks are interesting in that they reflect the effects of the two types of disturbance that present the greatest difficulty to the modem. These are fades associated with tropo links and harmonic distortion. The Pacific IST loops exhibited neither of these problems with the exception of two or three calls which involved tropo. The European error rates were dominated by the calls over tropo links which constitute approximately 60 percent of the calls. The CONUS lines do not involve tropo links but many of them do exhibit relatively high harmonic distortion content.

Figures 2.2.1-4, 2.2.1-5, and 2.2.1-6 indicate the performance of the one-way European, the one-way trans-Atlantic and the one-way trans-Pacific calls. The one-way trans-Atlantic calls were also characterized by relatively high harmonic distortion. Some evidence exists, however, that the primary cause of the distortion was the access line from the CONUS gateway switch to Ft. Dietrich rather than the actual trans-Atlantic lines. The harmonic distortion on the trans-Pacific calls was considerably smaller with resulting improvement in error rate.

Figures 2.2.1-7, 2.2.1-8, and 2.2.1-9 show the performance of the European access loops and the European and Pacific remote access loops. The performance shown in both of the remote access loop curves is dominated by the effects of tropo links. As discussed below, a number of these remote loops exhibited large line losses when the actual line loss should have been zero.

It was felt that in a number of these cases, the problem was due to the patching arrangement which was necessary at the remote switch to avoid insertion of an echo suppressor, or due to the manual loop patch, at the remote access location to provide the loop-around. The coordination of these calls was quite difficult from a communications standpoint and verification of the patching arrangements was not always possible. For instance, call 114, a remote loop to Vicenza, Italy from Feldberg, Germany, exhibited 16 dB line loss and provided a 16 kb error rate of 1.05 percent. The line was preempted before complete data was taken. A second call (115) to Vicenza was



1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
% OF ONE-WAY EUROPEAN 1ST CALLS WITH BER EQUAL TO OR LESS THAN ORDINATE
BER
16 kb
8 kb
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-4

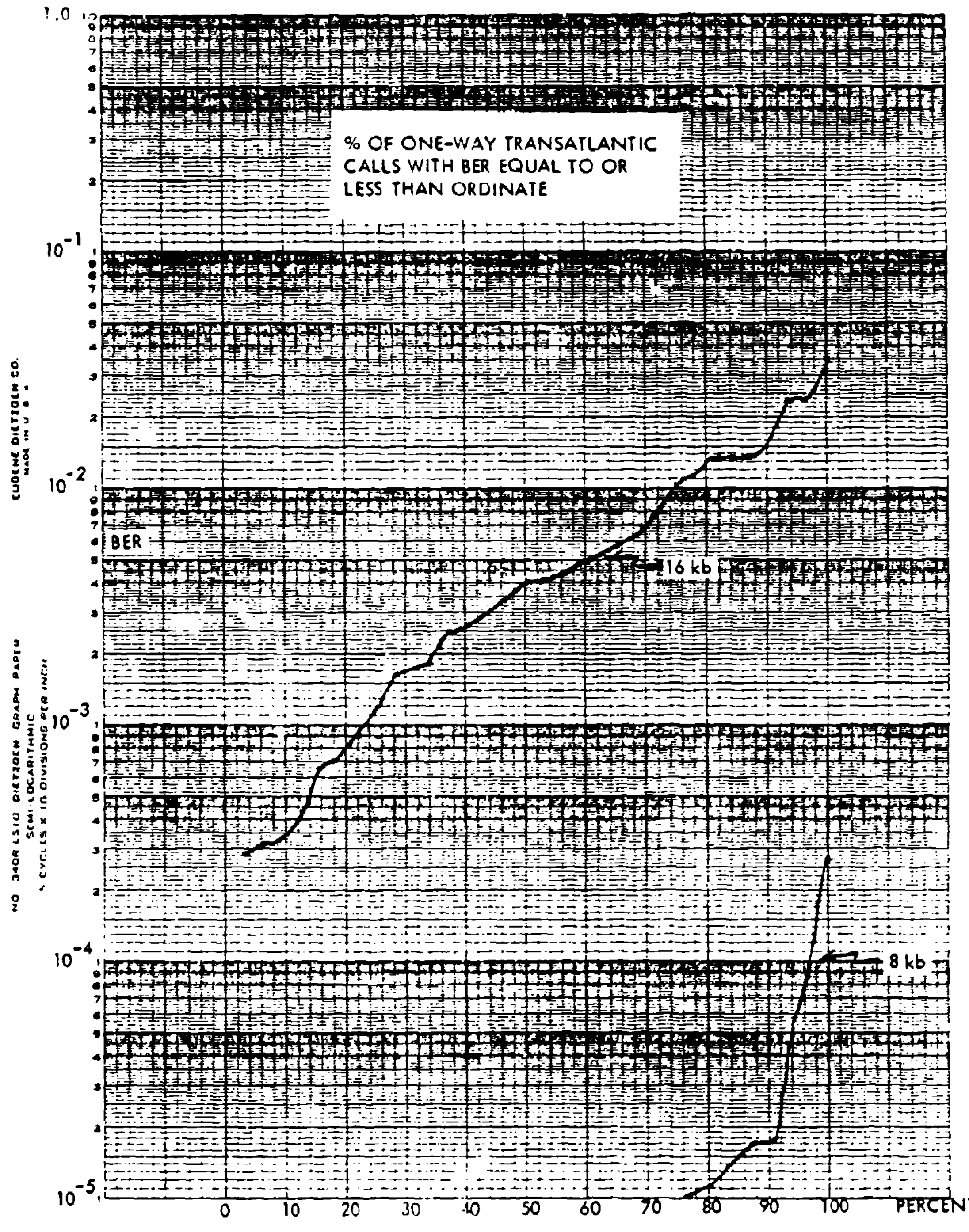

% OF ONE-WAY TRANSATLANTIC CALLS WITH BER EQUAL TO OR LESS THAN ORDINATE
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
BER
16 kb
8 kb
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-5

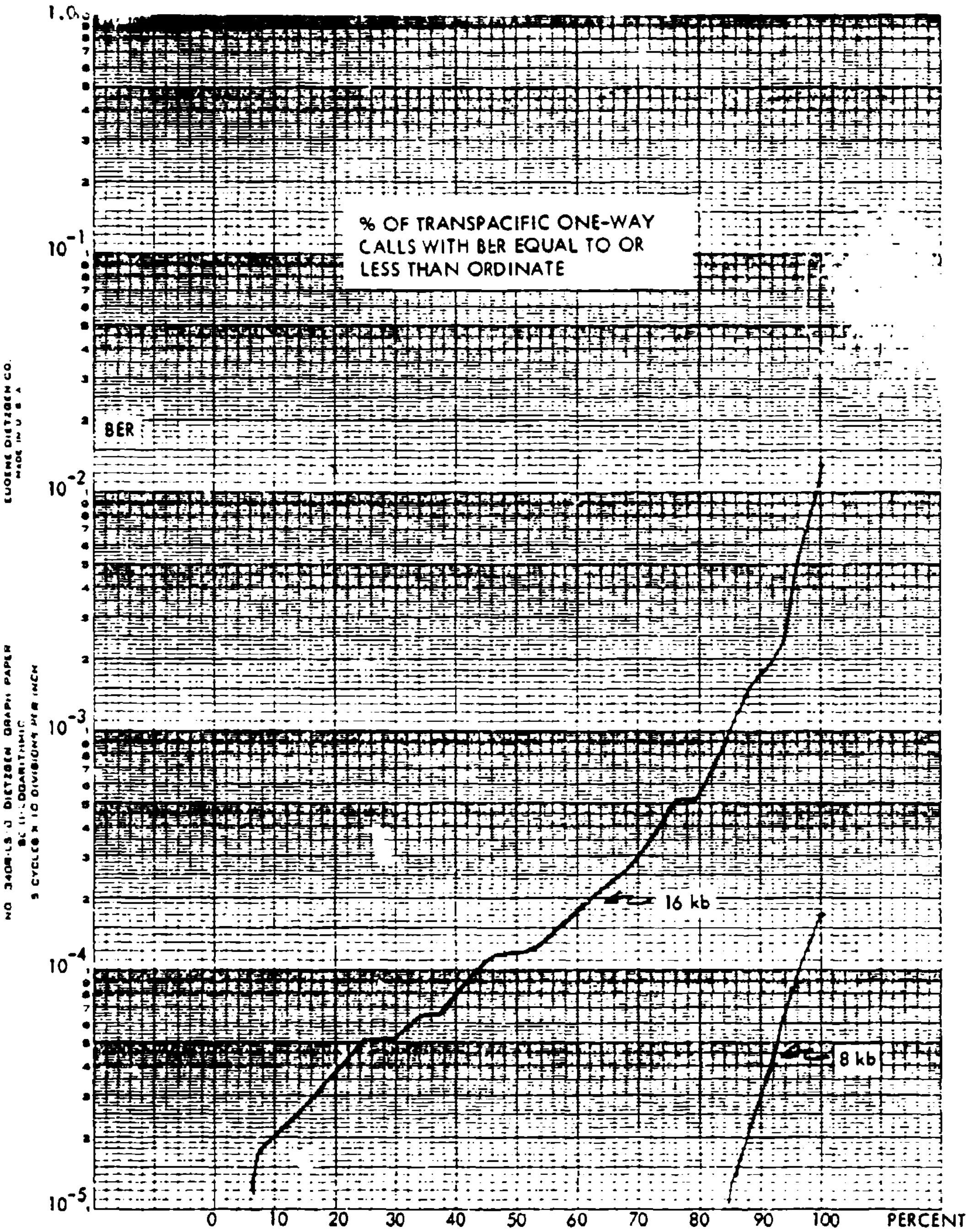

% OF TRANSPACIFIC ONE-WAY CALLS WITH BER EQUAL TO OR LESS THAN ORDINATE
BER
16 kb
8 kb
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-6

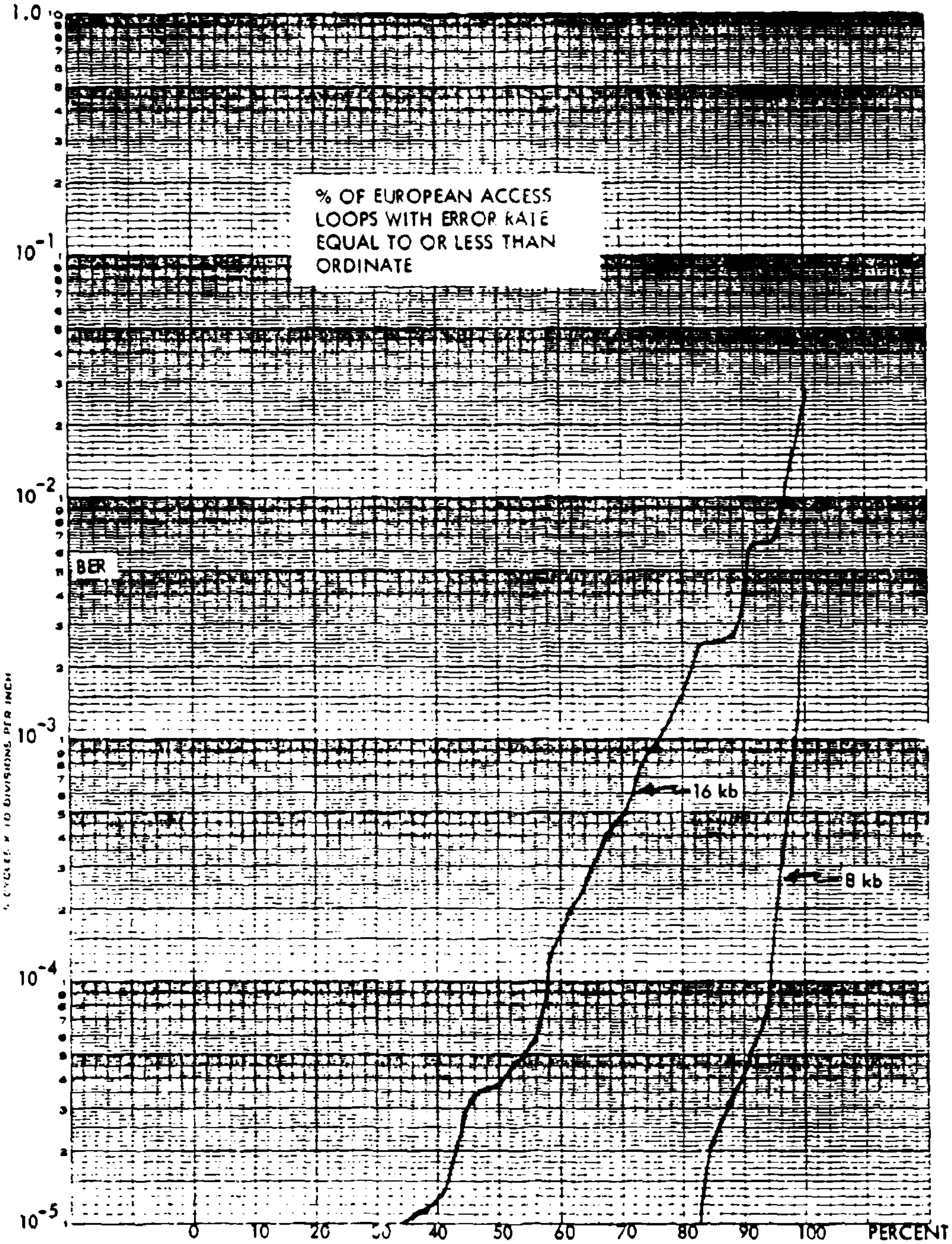

% OF EUROPEAN ACCESS LOOPS WITH ERROR RATE EQUAL TO OR LESS THAN ORDINATE
BER
16 kb
8 kb
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0 10 20 30 40 50 60 70 80 90 100 PERCENT

Figure 2.2.1-7

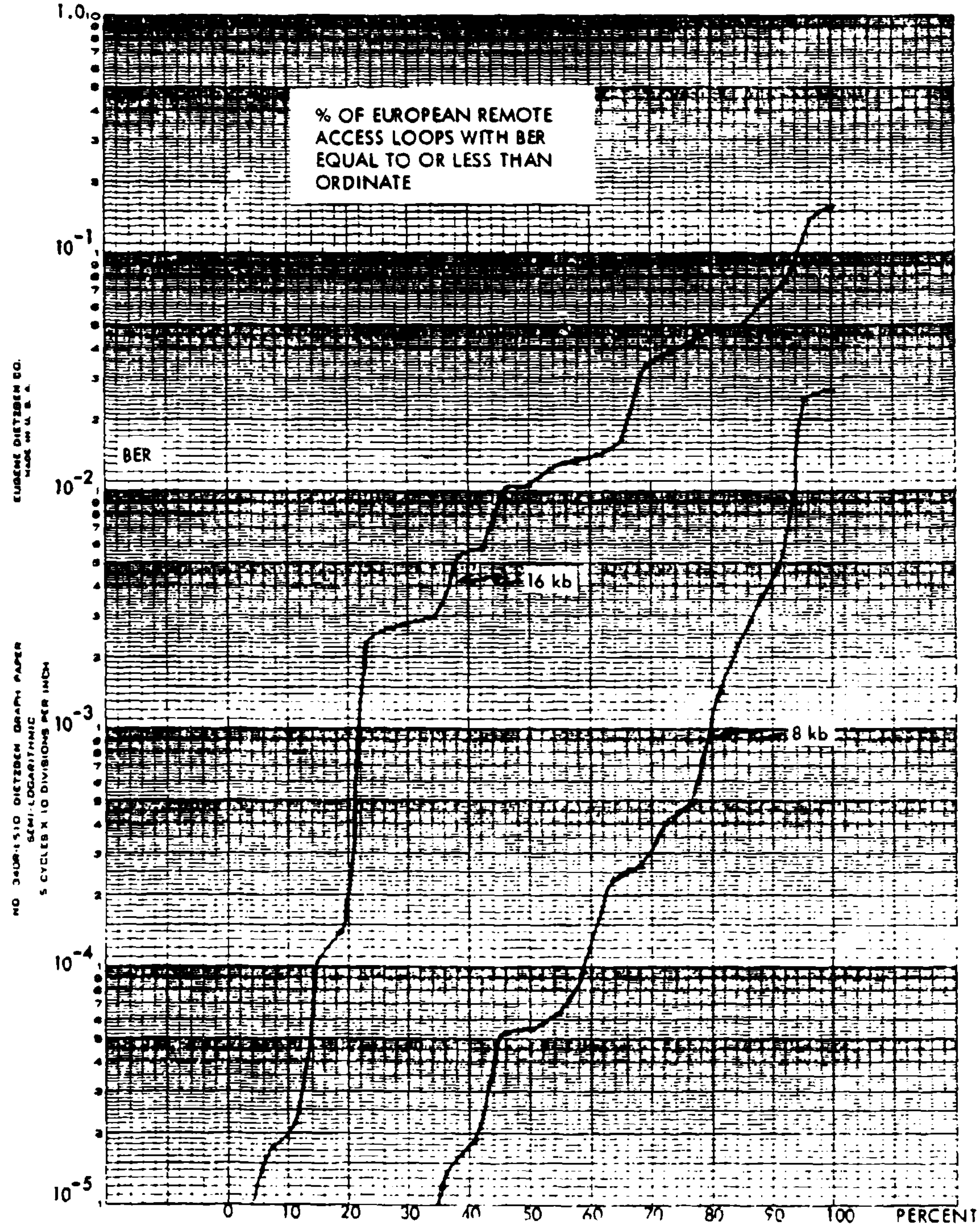
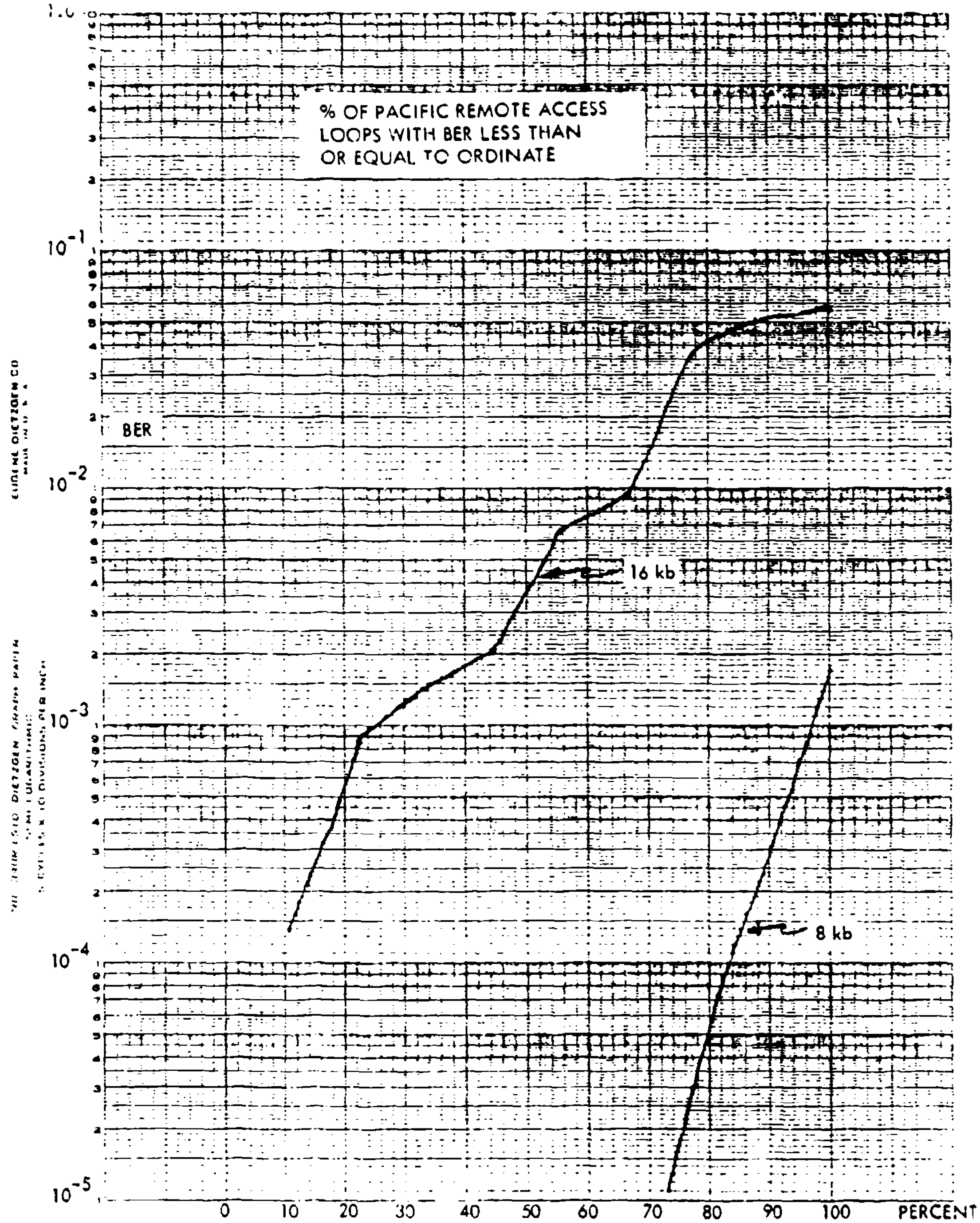

% OF EUROPEAN REMOTE ACCESS LOOPS WITH BER EQUAL TO OR LESS THAN ORDINATE
BER
16 kb
8 kb
1.0
10^-1
10^-2
10^-3
10^-4
10^-5
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-8



% OF PACIFIC REMOTE ACCESS
LOOPS WITH BER LESS THAN
OR EQUAL TO ORDINATE
BER
16 kb
8 kb
10-1
10-2
10-3
10-4
10-5
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.2.1-9

established over the same circuits as soon as the line became free. This time different personnel were utilized to provide the patches and the line loss was 6 dB with a resulting error rate of 0.229 percent.

As previously mentioned, the performance of the European calls and to a lesser extent, the Pacific calls was dominated by the error rates associated with those calls transiting tropo links. Of the 85 European IST loop calls, 49 of these transited one or more tropo links, and 33 did not involve tropo. (Calls with uncertain routing were excluded.) The median number of tropo links transited in these calls (taking into account the looped configuration) was six, and several IST loops transited 14 tandem tropo hops. Figure 2.2.1-10 shows the BER performance of the European IST loops separated into categories of those calls with one or more tropo hops and those with none. As can be seen, the worst error rate of the 33 loops which did not involve tropo was 5×10^{-3}. In addition to this categorization, it was noted that many of the calls with the worst error rates transited tropo link, T0055, between Coltano and Mt. Limbara. If those calls were excluded from the 49 calls involving tropo, it can be seen that the resulting performance of the remaining tropo links is better than that of all calls including the microwave links. The specific cause for the poor performance over this one link was not determined since the correlation was not discovered until after the tests were completed.

Figure 2.2.1-11 shows similar results for the one-way European IST calls. Twelve of the one-way calls involved tropo while eight did not. Figure 2.2.1-12 presents the performance with and without tropo for the European access loops. There were eight access calls involving tropo and 26 that did not. None of the access lines transited T0055. Figure 2.2.1-13 shows the results for the remote access lines in Europe. In this case, 18 calls involved tropo whereas eight did not. Again, omission of the tropo calls transiting T0055 makes a significant difference. Figures 2.2.1-14 and 2.2.1-15 present the performance with and without tropo for the Pacific calls. The effect is less pronounced in these cases because the number of calls involving tropo is much less. In the Pacific IST

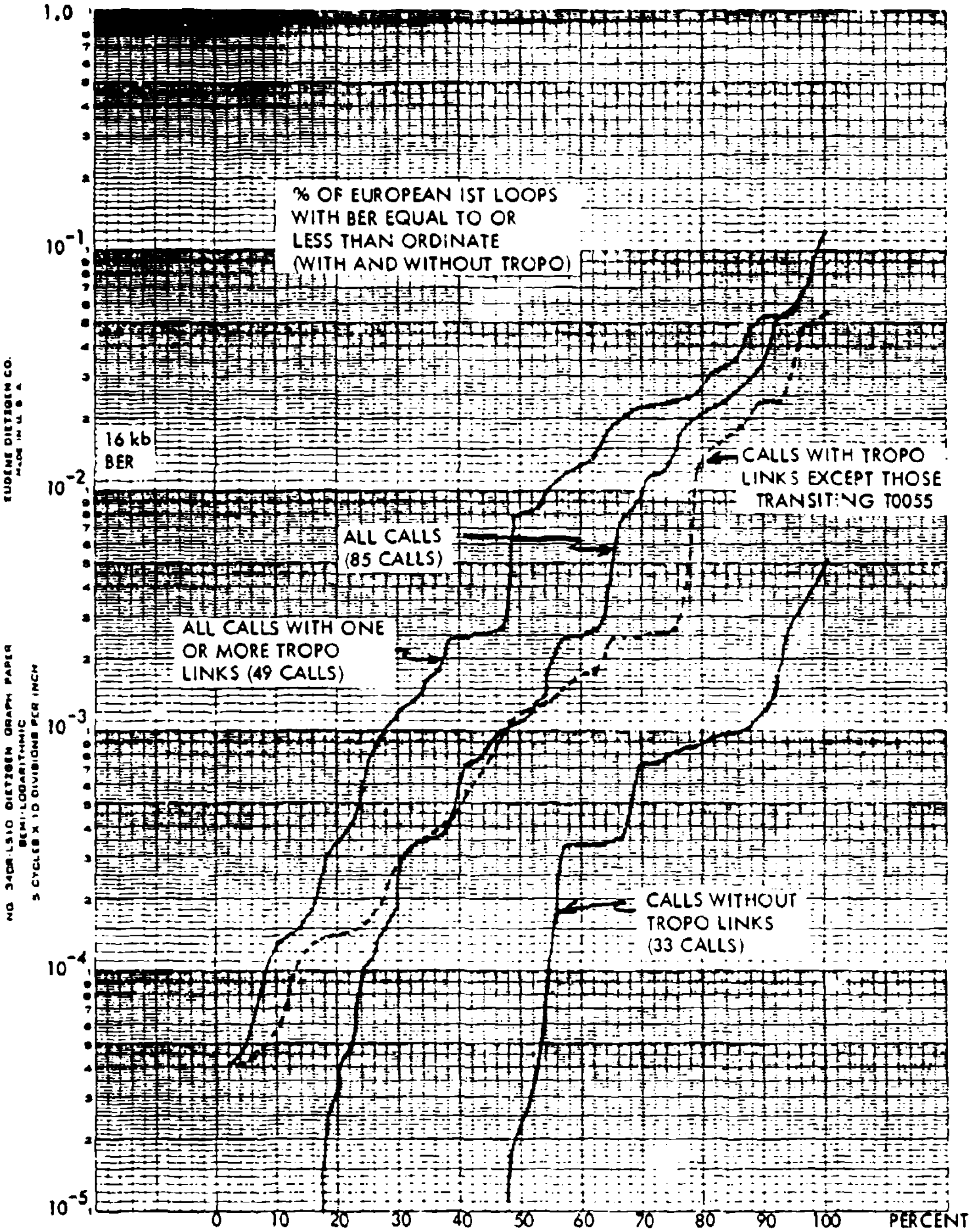


Figure 2.2.1-10

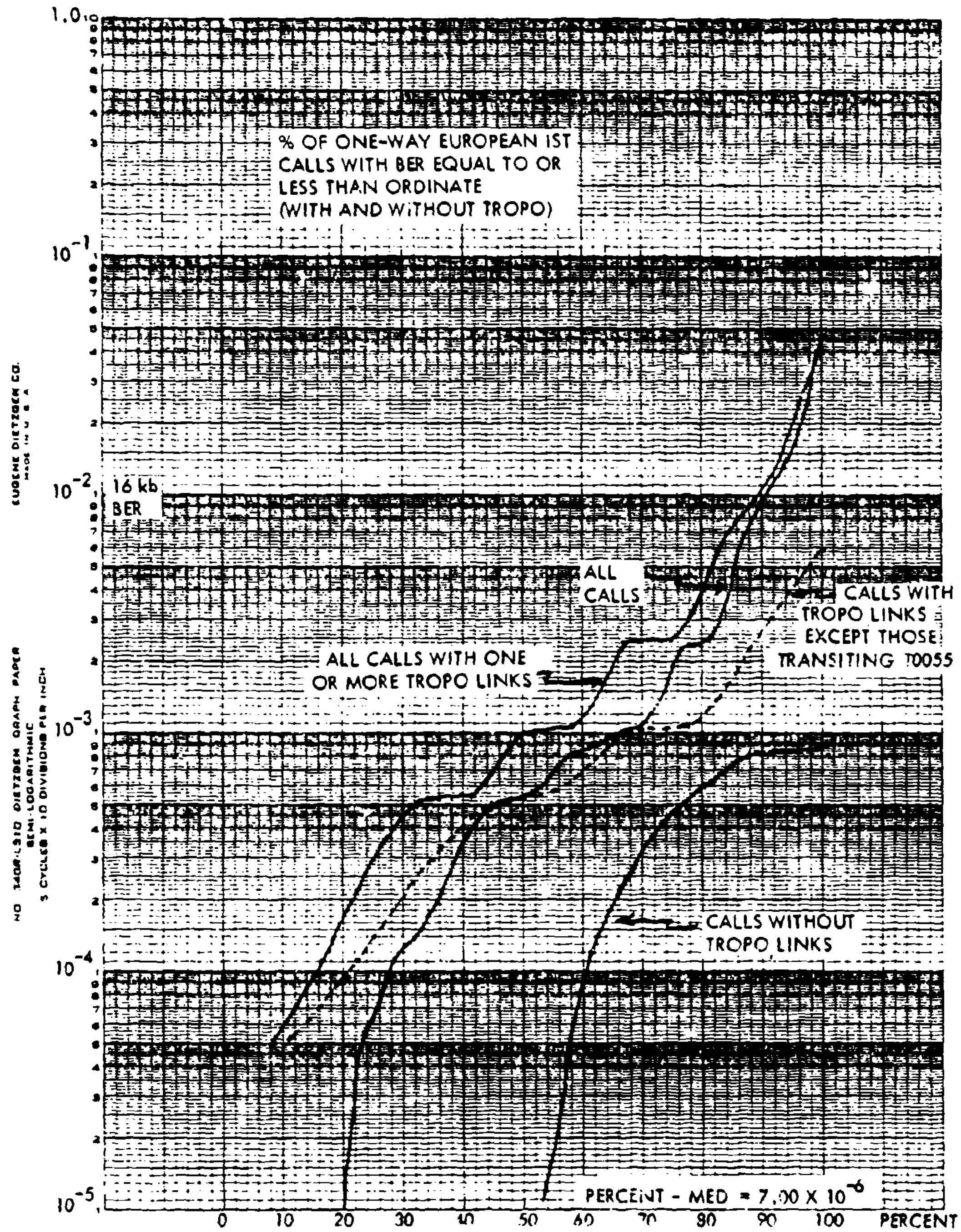


Figure 2.2.1-11

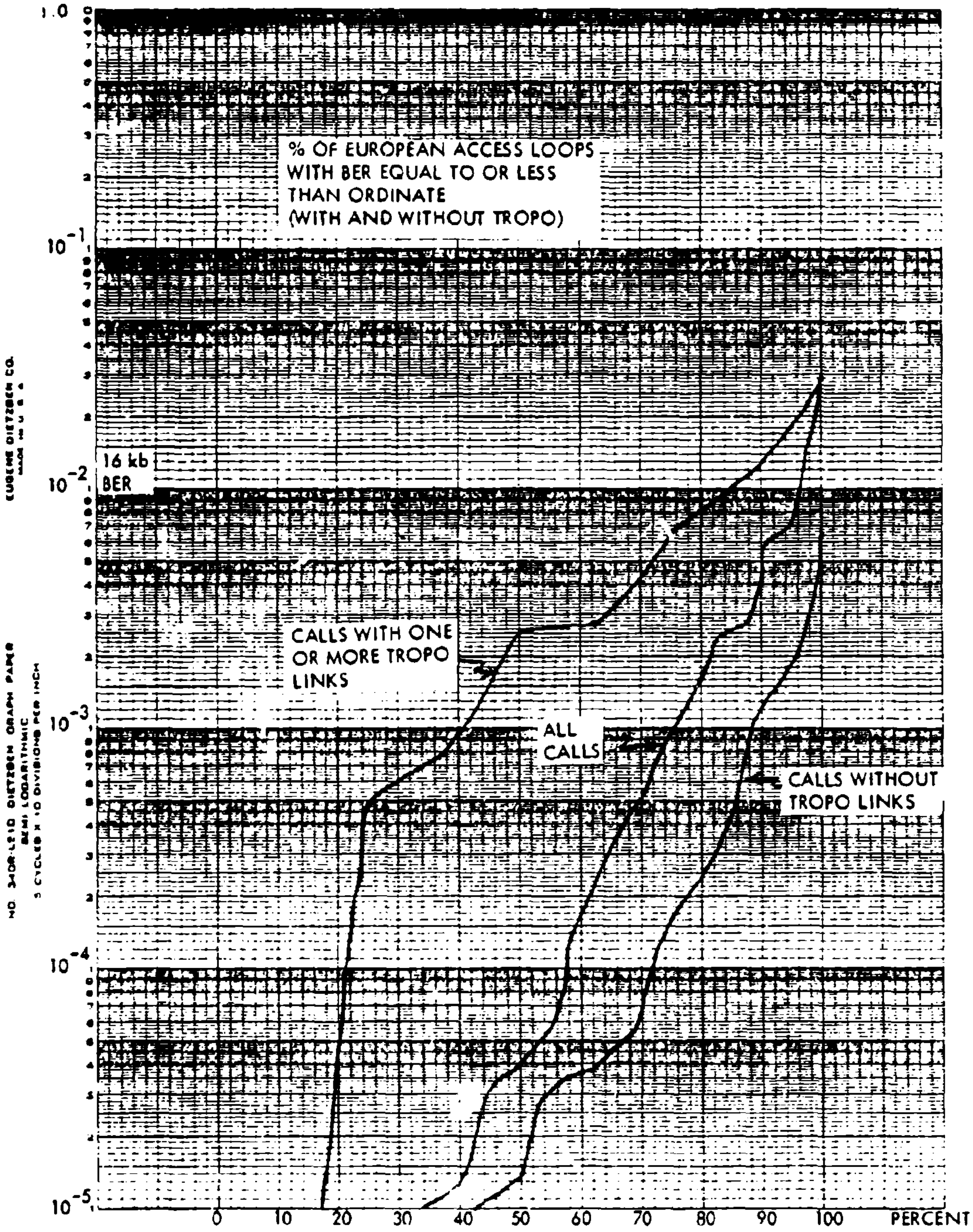


Figure 2.2.1-12

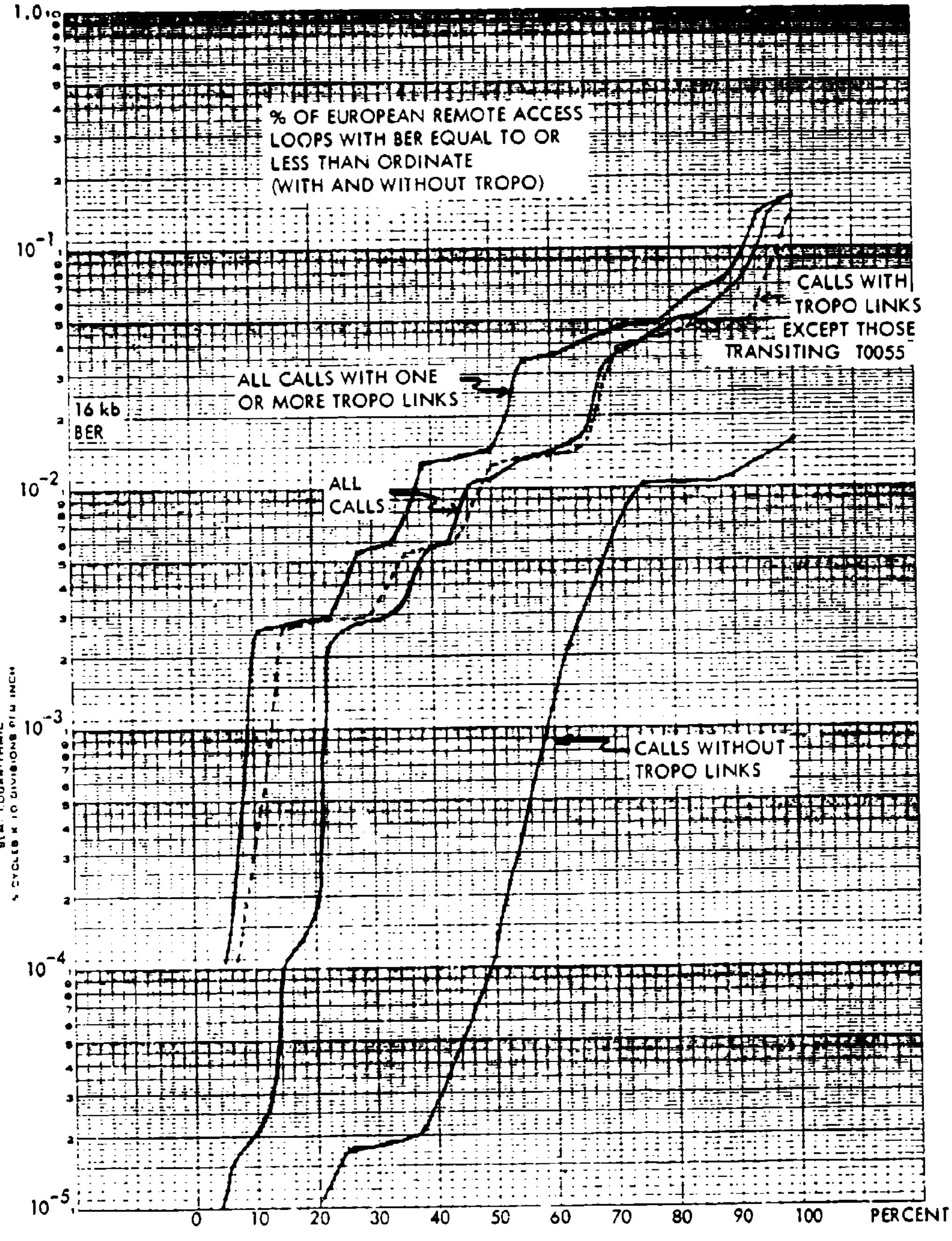


Figure 2.2.1-13

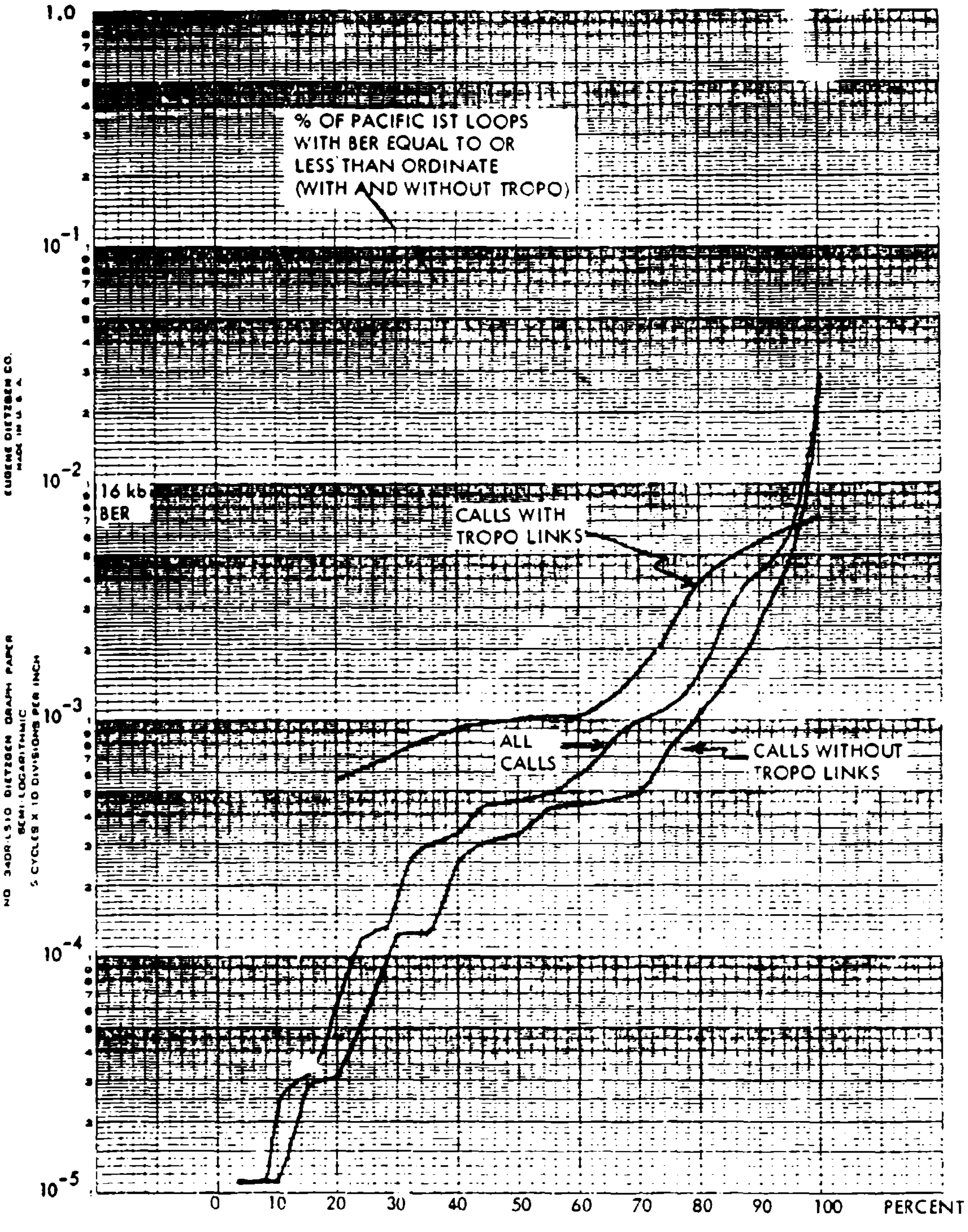


Figure 2.2.1-14

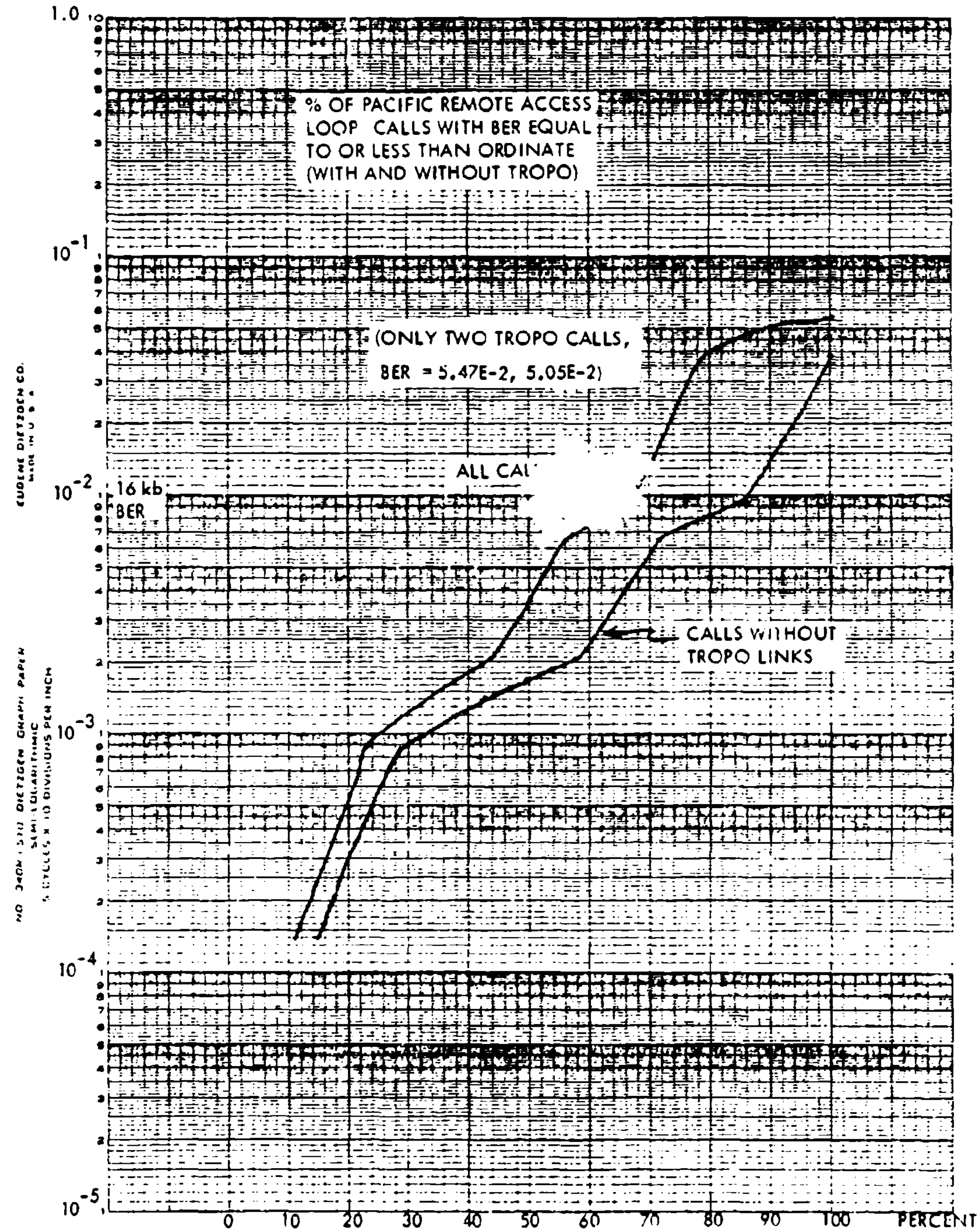


Figure 2.2.1-15

looped calls, five involved tropo and 20 did not. In the case of the remote access calls, two involved tropo and seven did not.

Figure 2.2.1-16 shows the BER performance of the CONUS loop when calls of different levels of distortion are excluded. As can be seen, the performance of the 21 calls with harmonic distortion less than 2 percent is considerably better than that of the 46 calls with harmonic distortion less than 3 percent which in turn is better than the performance for all 78 calls.

In evaluating the data associated with the CONUS testing it is worth noting that data obtained by testing of the CONUS network from a subscriber location can be easily dominated by the characteristics of the particular access line and not that of the IST's in the network. Figure 2.2.1-17 shows the CONUS IST looped data as measured from Melbourne, Florida, and the CONUS IST looped data previously taken from the RADC DICEF facility at Griffiss Air Force Base in Rome, New York. Although the modem design was improved slightly between the times that the two tests were conducted, the principal cause of difference is the higher harmonic distortion levels existing on the RADC calls which were undoubtedly associated with the digital access link from RADC to the AUTOVON switch at Tully, New York.

The conclusion that can be drawn from this is that the IST network is at least as good as it appears from a particular access location but may be better. Conversely, obtaining good performance over the IST network from a particular subscriber location does not guarantee good performance from all subscriber locations. However, if the number of subscriber locations causing problems is sufficiently small, it may be possible to do something about the access lines causing difficulty whereas poor performance on the IST network could likely not be corrected. In particular, D conditioned access lines, which have a specification in maximum distortion should improve bad lines significantly.

Figure 2.2.1-18 shows the performance on the European IST loops when calls which involved only V2 lines and those involving only S3 lines are separated. There

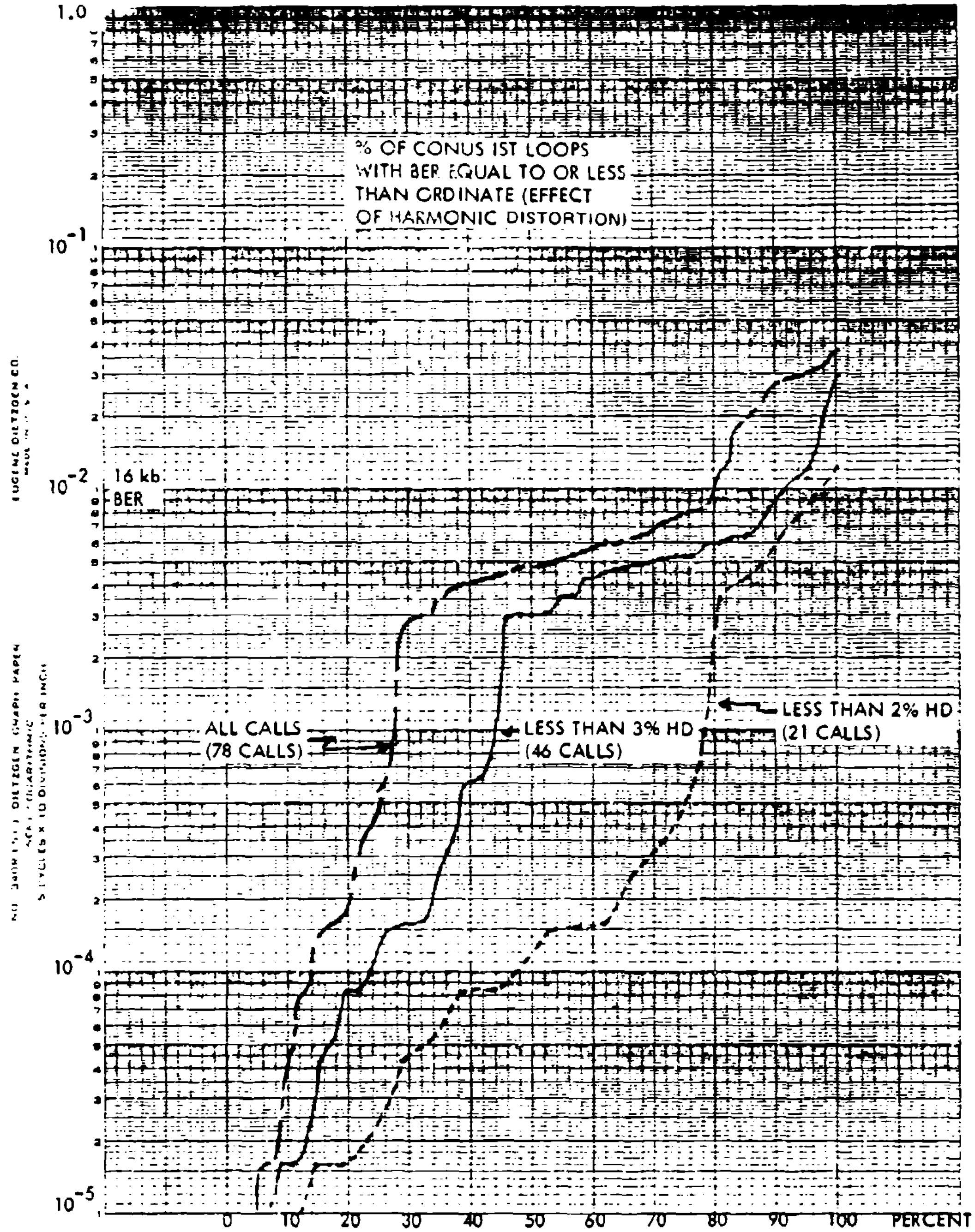


Figure 2.2.1-16

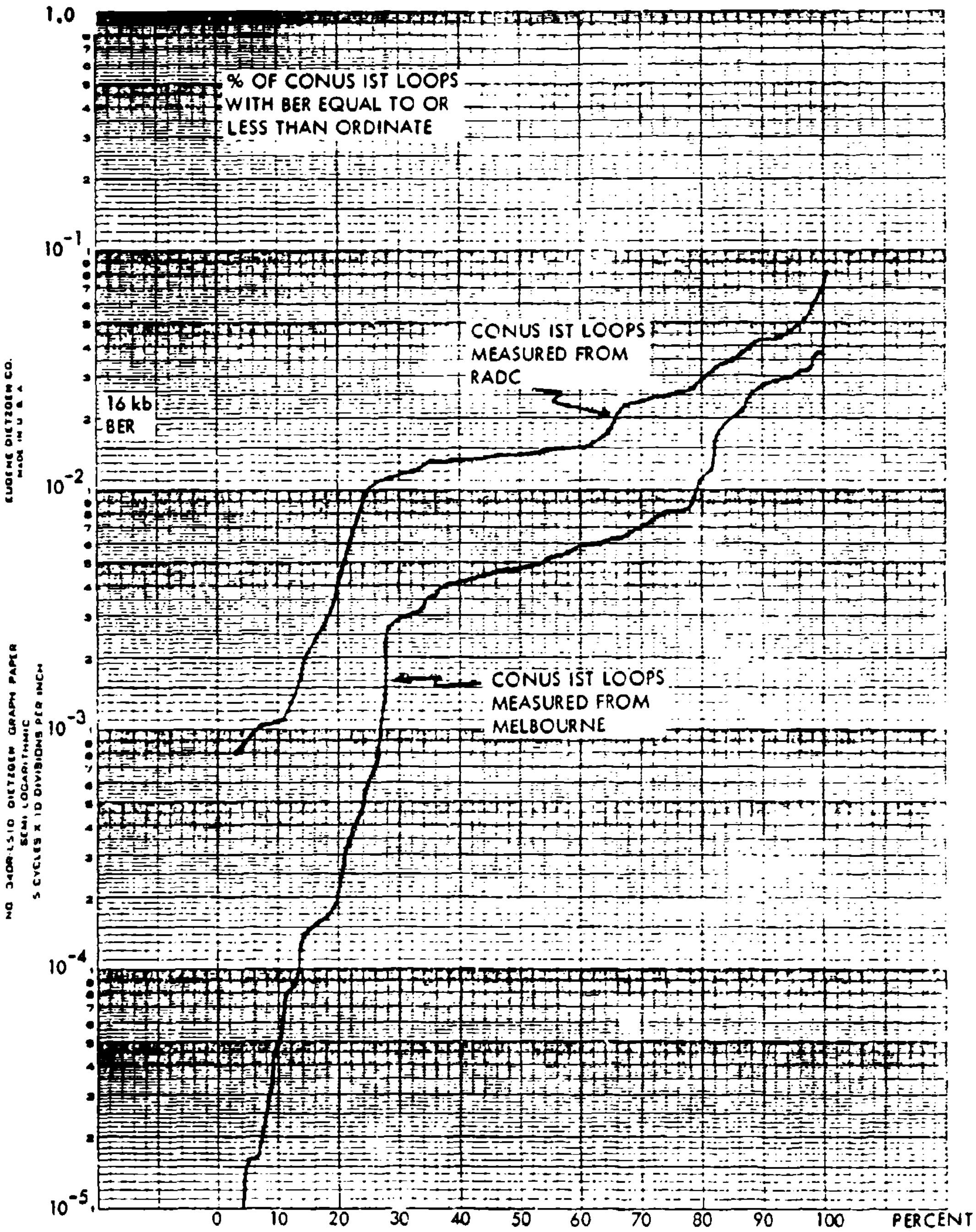


Figure 2.2.1-17

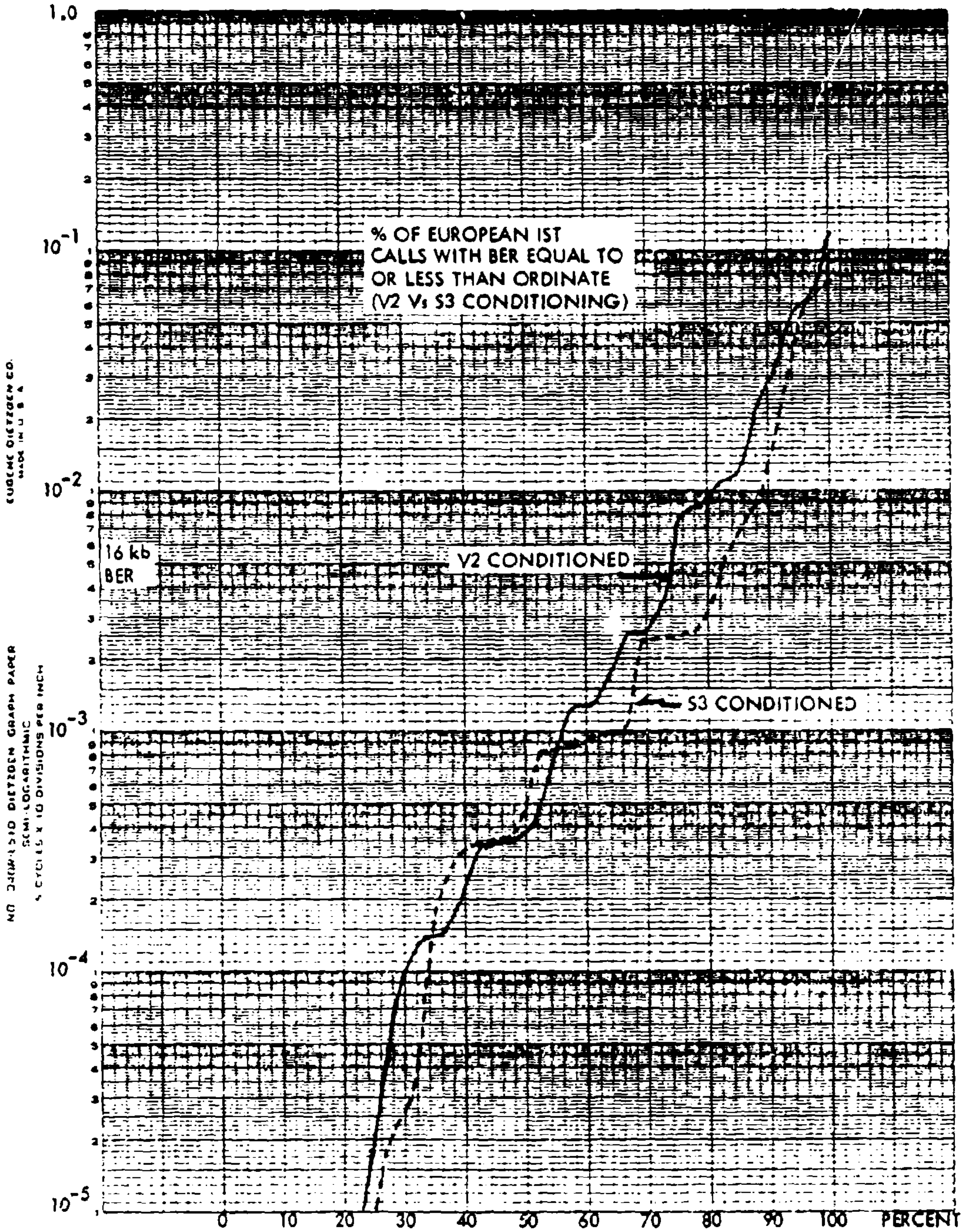


Figure 2.2.1-18

wer 33 calls involving only V2 conditioned lines and 19 involving only S3 conditioned lines. As can be seen, the performance difference is slight indicating that use of data grade lines would not provide significant performance improvement so far as the IST network is concerned. The European access calls involved too few S3 conditioned lines to make a comparison whereas the Pacific calls involved too few V2 lines to provide a valid comparison. The latter statement is due to the fact that virtually all Pacific IST lines are S3 conditioned. Hence dialing with or without the data grade prefix is unlikely to affect the quality significantly from a statistical point of view.

Figures 2.2.1-19, 2.2.1-20, and 2.2.1-21 present BER curves for the trans-Atlantic, trans-Pacific and the Pacific IST loop subdivided into undersea cable calls and satellite calls. The Pacific IST loops are further subdivided in terms of DSCS and COMSAT calls. In general, it is felt that no significant difference in voice quality exists between these types of calls, although some BER performance was better in some cases, specifically for COMSAT calls and cable calls. The cause of this better performance was not investigated.

Figure 2.2.1-22 shows the block throughput achieved (at 8 kb/s) on all nine categories of lines. As can be noted the block throughput of the European lines was worse than those elsewhere due to the higher percentage of lines with burst phenomenon. Figures 2.2.1-23, 2.2.1-24, and 2.2.1-25 show the percentage of calls which provided equalizer S/N ratio equal to or less than the ordinate. The equalizer S/N ratio is defined as the ratio of the equalizer error signal before equalization (with the weights zero) to that after equalization. The equalizer S/N ratio is not monotonically related to BER since some of the processing algorithms improve BER without affecting equalizer S/N. However, the data has been included since it may be of interest to other modem designers.

To better assess the meaning of the BER curves presented in this section, it is interesting to compare the 16 kb/s results with those previously obtained with other modems in the European network. Figure 2.2.1-26 shows the cumulative BER performance of one-way European IST calls made on the 16 kb/s modem and those made on several varieties of 2.4 kb/s modems and a 4.8 kb/s modem in tests conducted in 1971. The 2.4

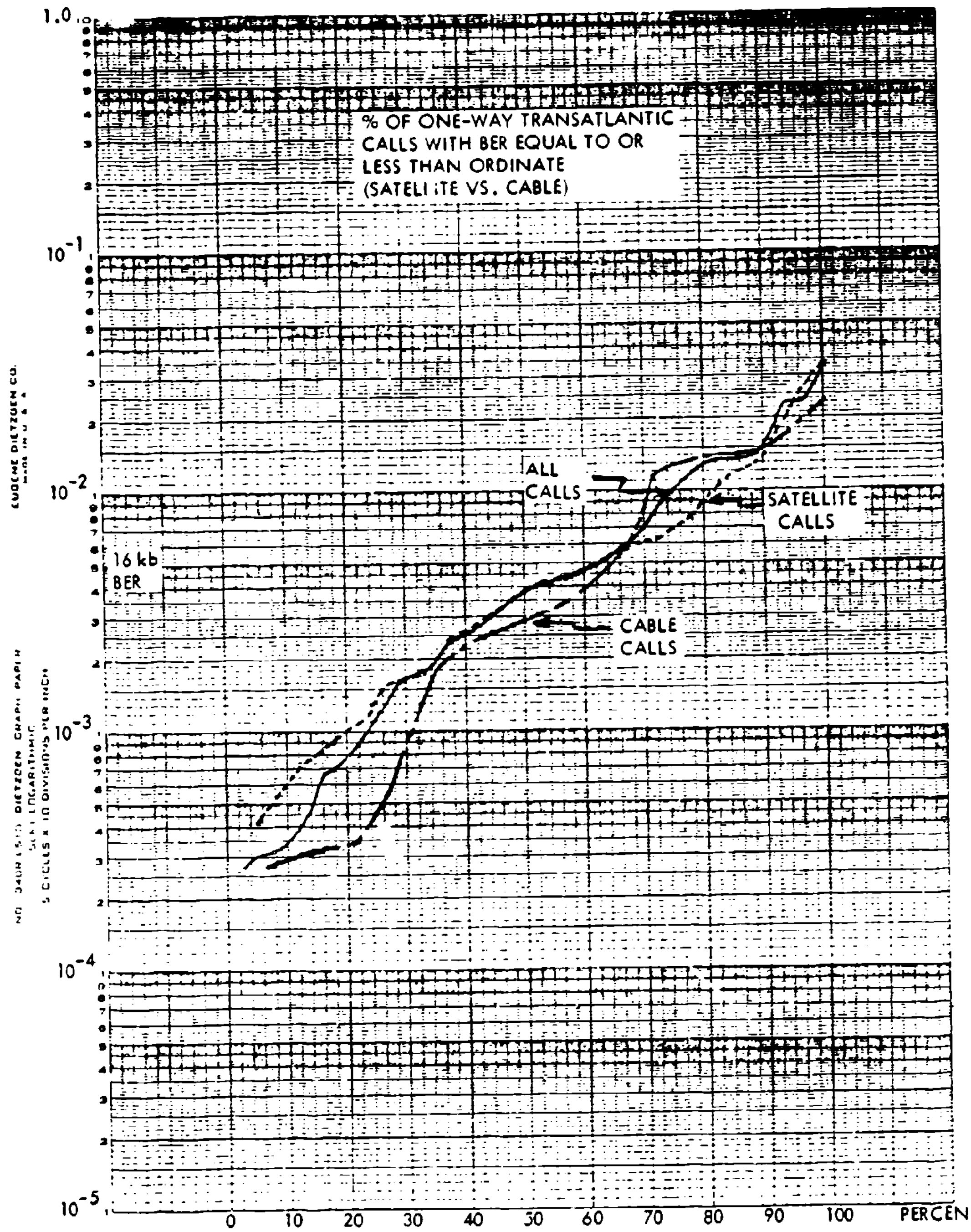


Figure 2.2.1-19

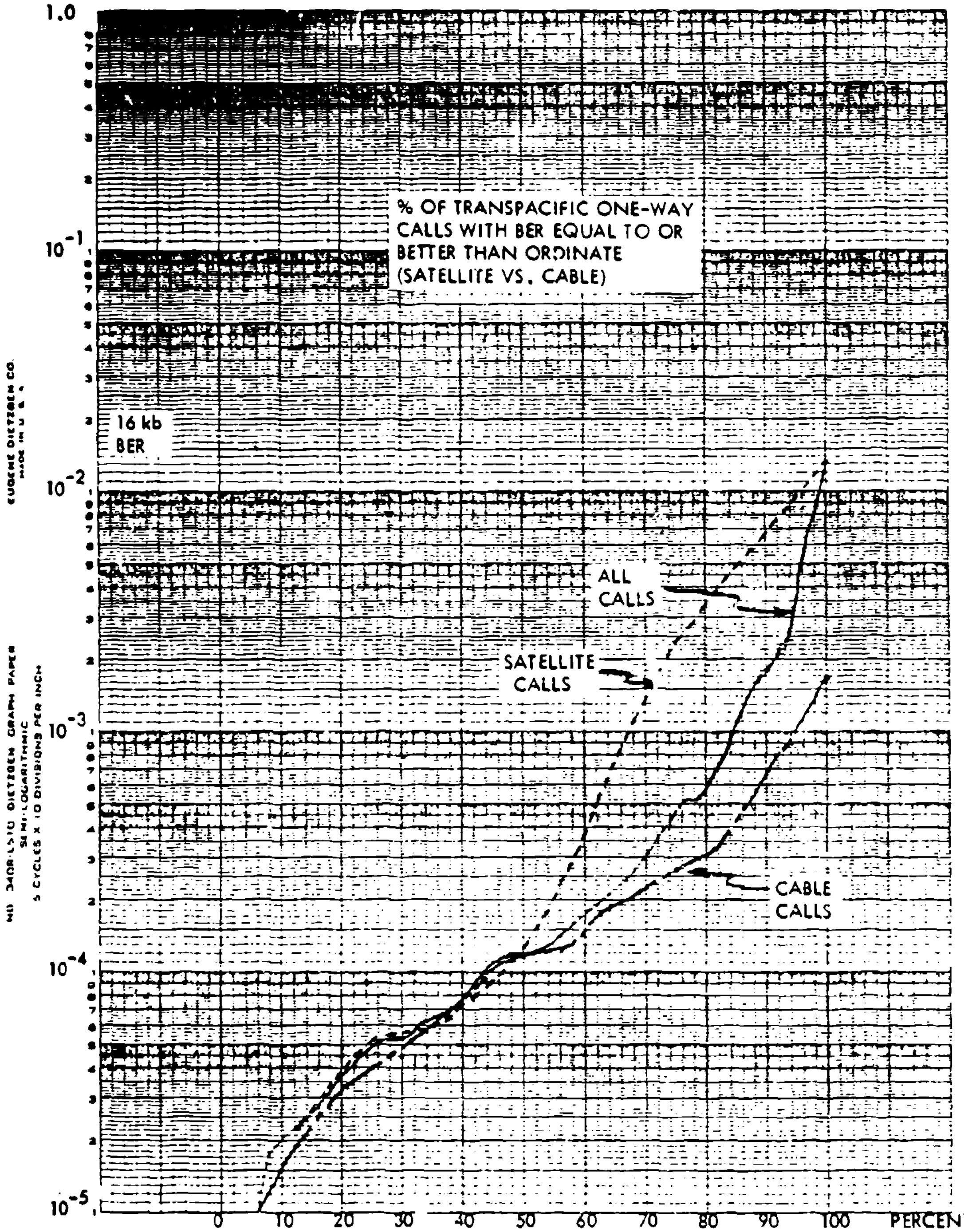


Figure 2.2.1-20

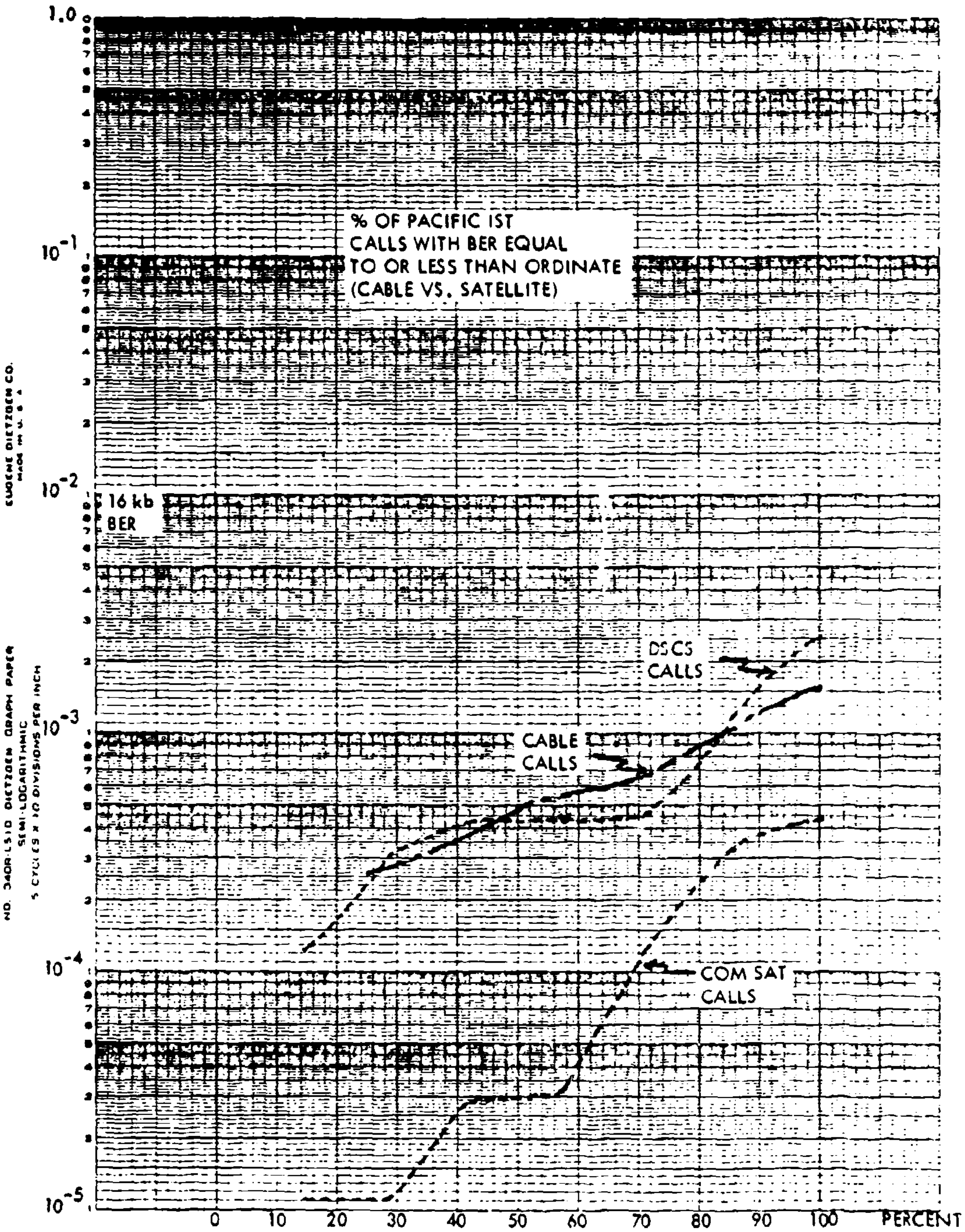


Figure 2.2.1-21

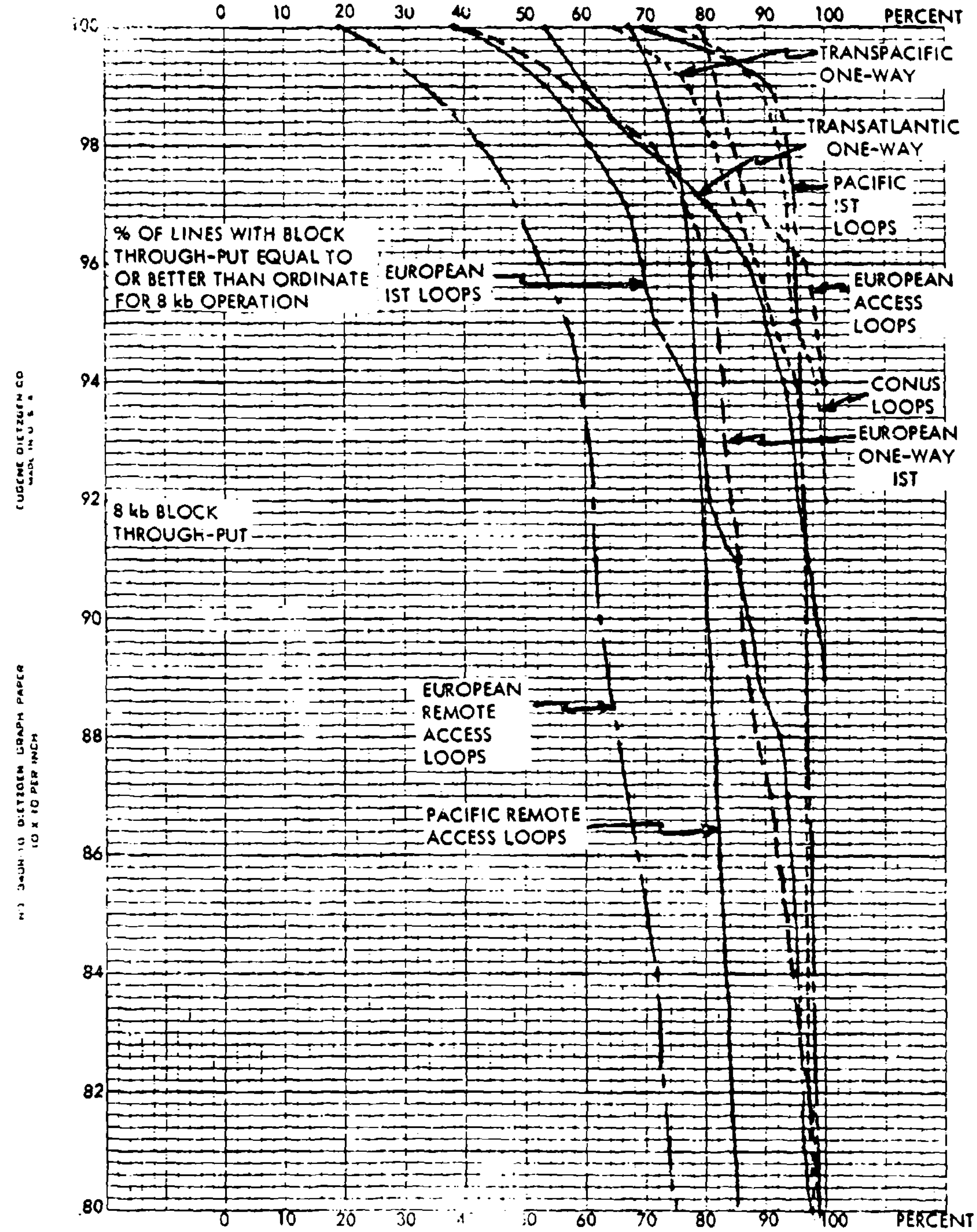


Figure 2.2.1-22

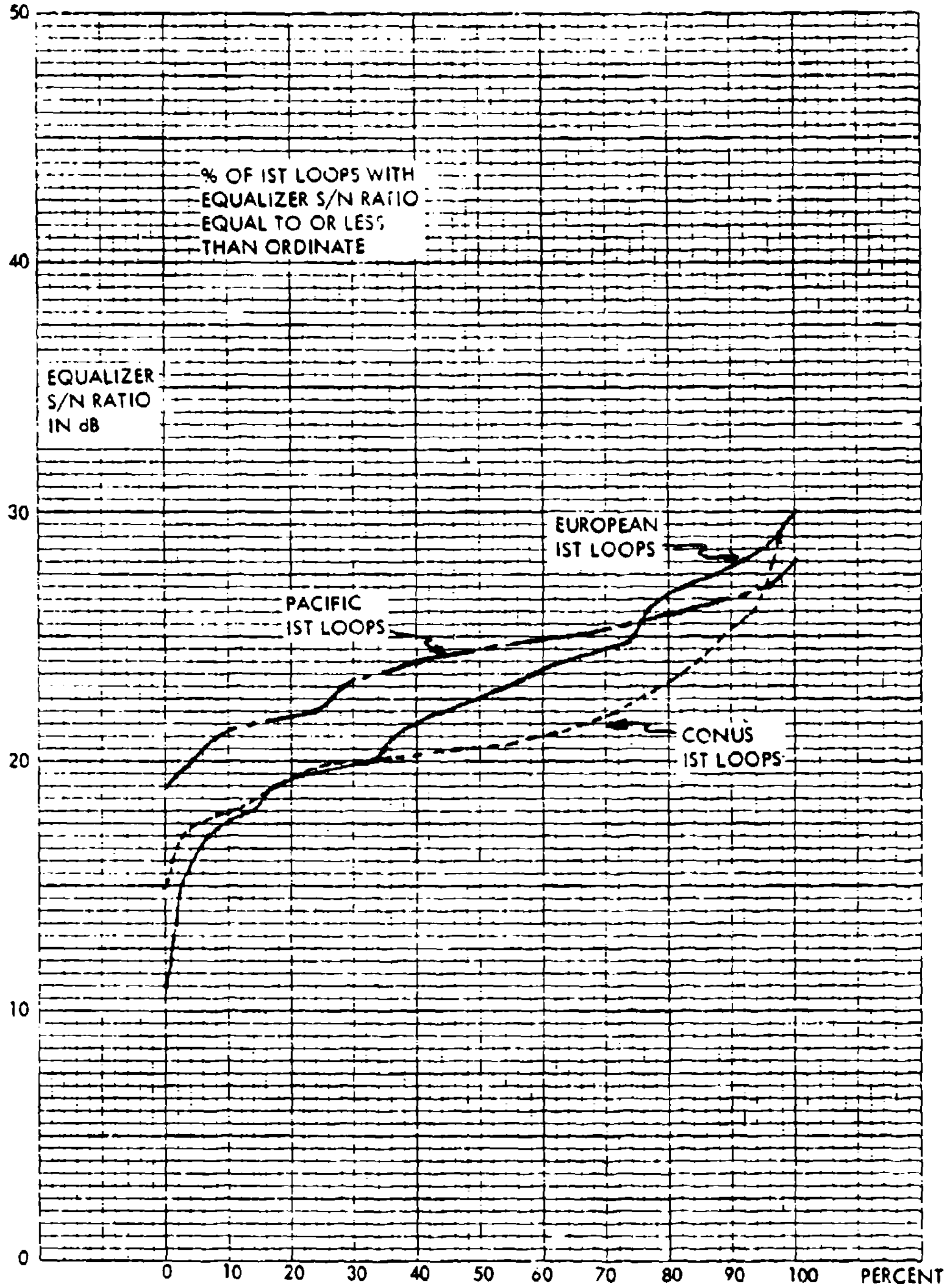


Figure 2.2.1-23

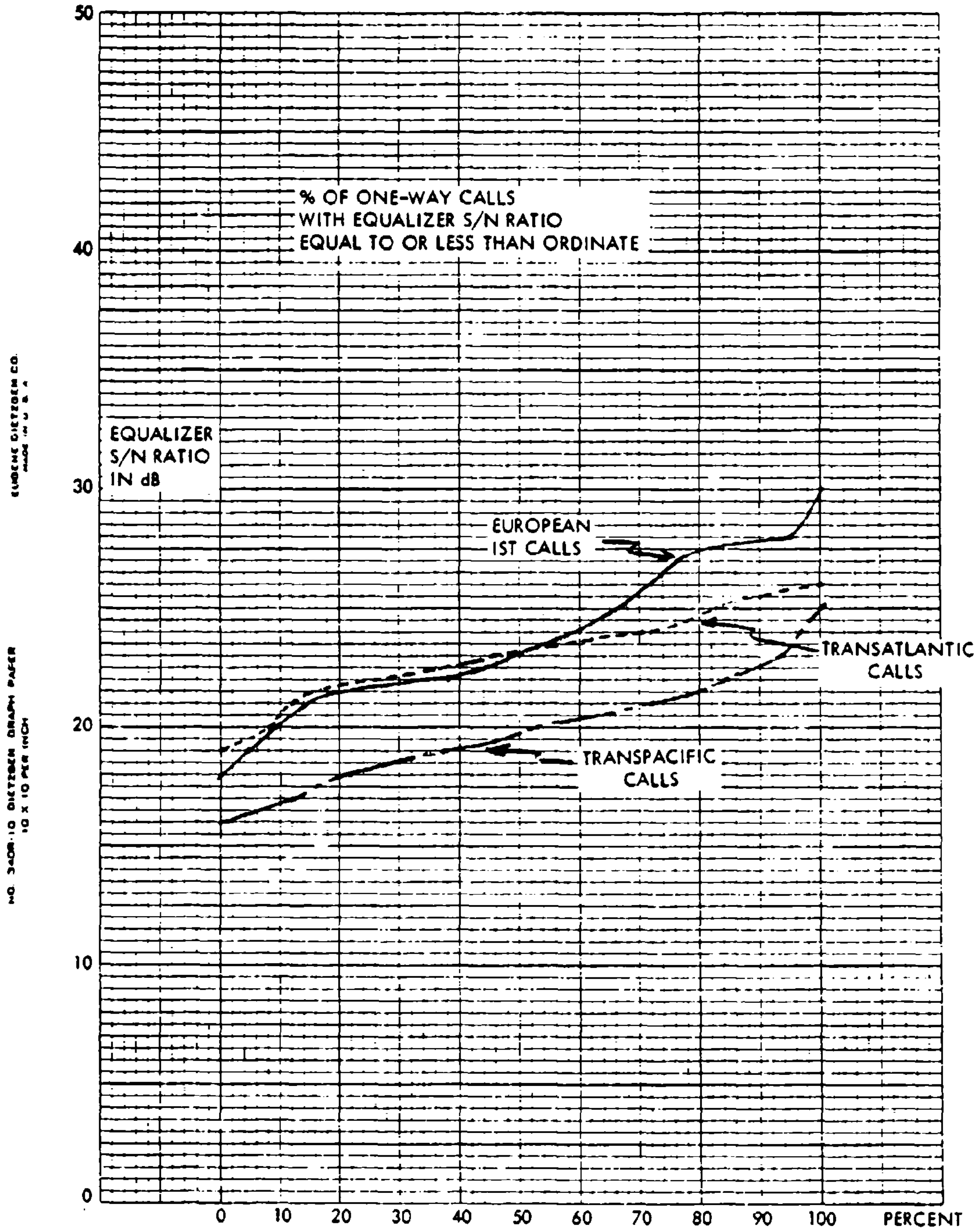


Figure 2.2.1-24

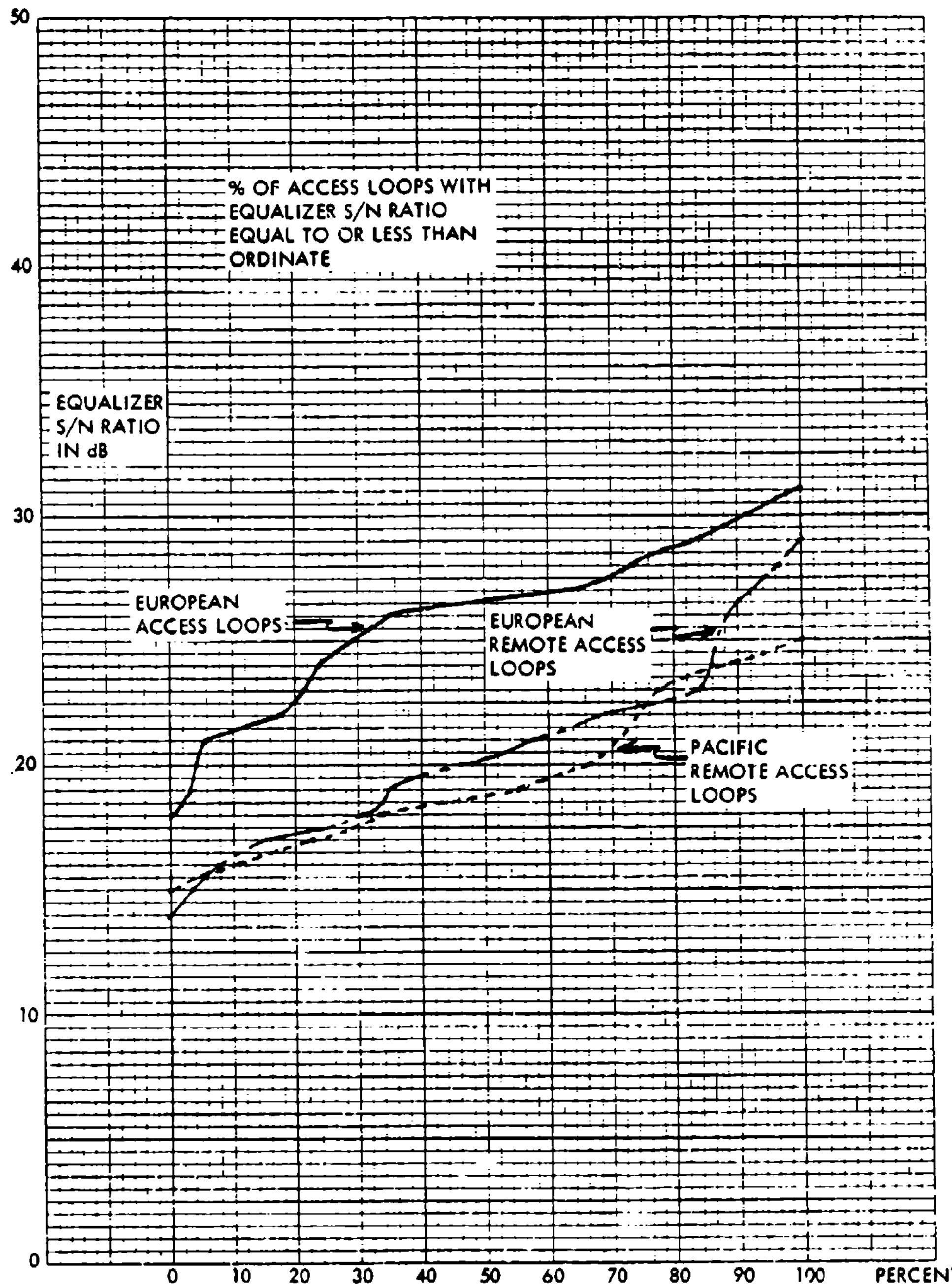


Figure 2.2.1-25

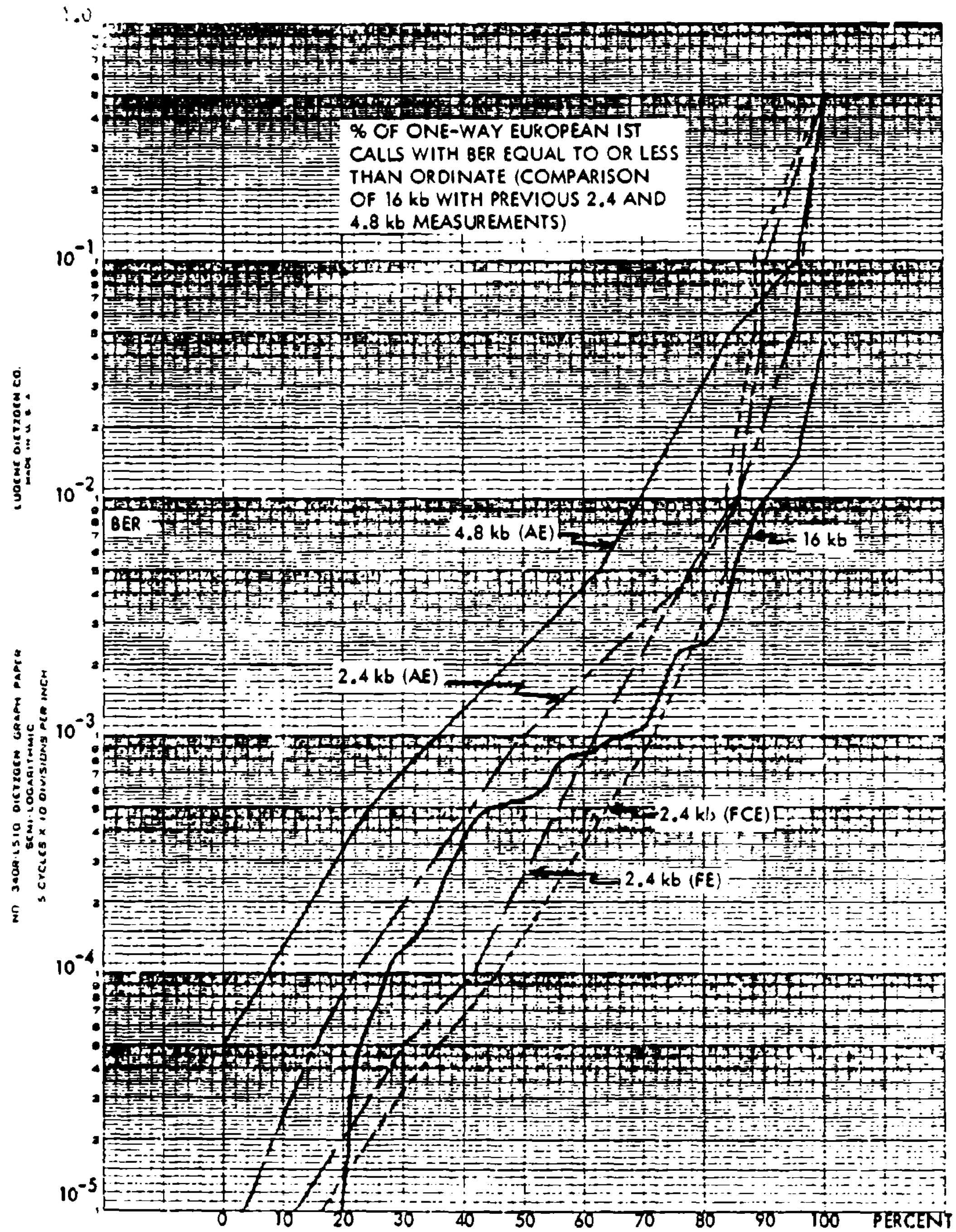


Figure 2.2.1-26

kb/s modem used was the DCS standard modem with several types of equalizers: a fixed equalizer (FE), a fixed compromise equalizer (FCE) and an automatic equalizer (AE). The measurements were made over voice grade circuits (one-way) on IST calls. As can be seen, in the region of error rates of concern to the 16 kb/s modem (BER $\geq$0.5%), the 16 kb/s error rates were better than the best of 2.4 kb/s configurations. The data concerning the 1971 tests is taken from RADC-TR-72-70.[2] Although it is recognized that the locations of testing were not the same and that the network has improved since 1971, the comparison is still interesting.

In a number of instances, European calls displayed significant signal level changes that ranged from 1 second in duration to 10 to 20 seconds of duration. The error rate performance following these was observed to be approximately the same as that prior to the disturbance when the disturbance did not occur during the training mode. This feature is felt to be significant in providing satisfactory operation in the environment imposed by the European network.

Two calls were placed from Feldberg which transited digital links associated with the FKV project. Since these are the only digital links in the overseas network, it represents the closest test available to indicate performance when portions of the future network are digitized. Call number 74 from Feldberg to Stuttgart through Vaihingen was looped on a digital link from Stuttgart to Vaihingen in tandem with three microwave links and a tropo link from Feldberg to Vaihingen. The 16 kb/s BER on this call was 6.53×10^{-3}. This call involved two tandem a/d-d/a conversions since the loop back patch at Stuttgart was made at an analog point. Call number 90 from Feldberg to Vaihingen to Stuttgart to Kaiserlautern to Heidelberg transited six tandem digital links with a/d-d/a conversions on each. In addition, it transited the microwave and tropo links to Vaihingen and a government land line from Kaiserlautern to Heidelberg. The looped BER on this call was 2.53×10^{-3}. On both calls, the harmonic distortion was less than 1 percent. Both the error rate data and harmonic distortion numbers appear to be quite encouraging relative to performance through digital links in the future network.

2.2.2 Network Coverage

As was discussed in Section 2.1 it was an objective of the tests to "cover" as much of the network as possible so that the results would be as representative as possible of the operation of the modem in the network. On most calls the routing of the calls was traced so that the network coverage could be evaluated.

All AUTOVON switches in Europe have dialed loop-around capability. Thus it is always possible to obtain an IST loop to any of the 10 switches by simply dialing a special number. The switching strategy of the European network is such that a call placed from one switch to another will follow one of, at most, three routes to that switch so far as routing through other switches is concerned. Thus, a call placed from Hillingdon, England to Humosa, Spain may go directly (primary routing); it may go via Langerkopf and Donnersburg in Germany (secondary routing) or it may go via Feldberg, Germany and Mount Vergine, Italy (ternary routing). If all circuits on these three routings are busy with calls of equal or higher precedence a busy signal will occur. The routings associated with these switch to switch calls are referred to as engineered routings.

When placing the IST loop-around calls, all of the engineered routings from each of the three switch locations selected as test sites were obtained. This was achieved by first dialing the loop-around number of the other switches which usually resulted in a primary routing. The remaining secondary and ternary routings were obtained by seizing a trunk to the next switch involved in the routing and dialing the loop-around number from that location. In general, routings that resulted in poor error rate performance were selected for repeat calls when time was available. In addition, routings involved in one-way tests produced repeat calls on the loop-around connections. It should be noted that although there are no more than three routings from one switch to another, as far as the interconnecting switches are concerned, there may be a number of different circuit routings from one switch to another.

The European IST network is shown in Figure A-1 of Appendix A. All of the interswitch traffic transits a network involving 40 microwave links, 11 tropo links, 4 leased Telpak links and 3 diffraction links. During the course of European testing all of these links were utilized for at least one call. There are 41 different routes involved in interswitch circuits. Thirty of the routes were transited during the European testing. The remaining 11 that were not transited contain less than 4 percent of the IST circuits.

Table 2.2.2-1 lists the routings of interswitch circuits for the European AUTOVON network. The first column indicates the two switches that the circuit connects. (Table 2.2.2-2 identifies the locations corresponding to abbreviations given in this report.) The second column indicates the location of baseband patches involved in the connection. The next four columns indicate the number of microwave (M), tropo (T), diffraction (D), and leased Telpak (L) links employed by the circuit. The seventh column is the distance involved in statute miles. The next three columns indicate the number of V2 and S3 conditioned circuits and the total number of circuits on that routing. The last two columns indicate the number of different circuits on that routing involved in the 16 kb testing and the total number of calls using that routing. In all there are 41 different routes involved and 15 transit only microwave links. Twenty-two use at least one tropo link, eight use at least one diffraction link and six use at least one Telpak link. Of the 357 circuits involved, 198 or about 56 percent of them are S3 conditioned. Of the 357 different circuits, 104 were used during the tests representing 29 percent of all the IST voice circuits.

Good coverage of the network involved with access lines is much harder to obtain because of the large number of different access locations, as well as the increased difficulty in achieving loop-around connections to these locations (no usable automatic loop-around capability exists). This difficulty was especially severe in the case of remote access loops since echo suppressors which normally are employed on all such calls had to be disabled. Further many of the access locations involved in the network have only one voice channel and inherently do not have a capability to provide a loop-around.

Table 2.2.2-1. Routings of European IST Circuits

	Via	M	T	D	L	Dist	V2	S3	Total	No. Channels	No. Calls
HIN-FEL	MAM	6	2	1	0	446	2	0	2	0	0
HIN-FEL	—	13	0	0	0	446	5	8	13	6	15
HIN-DON	FEL	15	0	0	0	490	0	5	5	1	1
HIN-LKF	—	13	0	0	0	445	6	8	14	3	5
HIN-MAM	—	5	0	0	0	102	15	19	34	5	11
HIN-HUM	FEL, LKF	24	4	0	0	1605	1	0	1	0	0
HIN-HUM	RTA	0	0	0	2	1632	3	1	4	2	4
HIN-HUM	—	0	0	0	1	932	0	4	4	3	8
HIN-MRE	HUM	1	4	0	1	1835	0	4	4	3	5
HIN-MRE	MAM, FEL, MCA	23	2	0	0	1476	3	0	3	3	10
MAM-FEL	—	1	2	1	0	344	8	5	13	4	15
MAM-DON	—	3	2	1	0	388	7	5	12	5	7
LKF-SCH	—	2	0	0	0	96	3	5	8	2	2
DON-MRE	CLO	0	3	2	0	923	5	6	11	1	1
DON-MRE	CLO	0	1	2	1	775	0	2	2	0	0

Table 2.2.2-1. Routings of European IST Circuits (Continued)

	Via	M	T	D	L	Dist	V2	S3	Total	No. Channels	No. Calls
DON-MRE	FEL, MCA	12	2	0	0	1104	2	0	2	0	0
DON-CLO	—	0	1	2	0	485	3	7	10	6	10
DON-CLO	LKF	10	0	0	0	525	2	0	2	2	3
DON-LKF	—	1	0	0	0	23	17	18	35	2	2
DON-PAT	FEL, MRE	12	5	0	0	1620	0	2	2	0	0
DON-PAT	CLO	0	6	2	0	1439	3	1	4	1	1
DON-PAT	LKF, CLO	10	5	0	0	1479	0	1	1	1	1
DON-HUM*	LKF	11	4	0	0	1450	2	5	7	3	5
DON-HUM*	LKF,CLO	11	4	0	0	1450	1	0	1	0	0
DON-HUM	CLO	1	5	1	0	1410	2	2	4	1	2
DON-SCH*	FEL	4	0	0	0	141	1	1	2	0	0
DON-SCH*	—	4	0	0	0	141	3	5	8	2	2
DON-SCH	LKF	3	0	0	0	119	2	0	2	0	0
DON-FEL	—	2	0	0	0	44	14	16	30	9	12
HUM-MRE	—	1	4	0	0	903	8	10	18	6	8

Table 2.2.2-1. Routings of European IST Circuits (Continued)

	Via	M	T	D	L	Dist	V2	S3	Total	No. Channels	No. Calls
CLO-MRE	—	0	0	0	1	290	3	4	7	6	31
CLO-MRE	—	0	2	0	0	438	1	1	2	0	0
MRE-PAT	—	0	3	0	0	516	7	10	17	6	10
FEL-LKF	—	1	0	0	0	70	14	16	30	6	6
FEL-CLO	—	10	0	0	0	622	2	7	9	6	12
FEL-CLO	SGT	14	0	0	0	884	1	1	2	2	8
FEL-MRE*	—	10	2	0	0	1064	8	2	10	4	7
FEL-MRE*	MCA	10	2	0	0	1064	0	6	6	1	2
FEL-MRE*	CLO	10	2	0	0	1064	1	2	3	0	0
FEL-MRE	LKF, CLO	10	0	0	1	815	0	1	1	0	0
FEL-SCH		2	0	0	0	97	4	8	12	2	3
Totals 41		256	67	12	7		159	198	357	104	209

*Routings which are identical except for the location of baseband patch.

Table 2.2.2-2. Locations and Abbreviations

Abbreviation	Location	Abbreviation	Location
ABG	Augsburg, Germany	CHA	Chatham, North Carolina
ANK	Ankara, Turkey	CHE	Chesterfield, Massachusetts
ANU	Adenau, Germany	CHR	Christchurch, England
ANY	Alconbury, England	CHV	Charlottesville, Virginia
APA	Apache Junction, Arizona	CKS	Chicksands, England
ATH	Athens, Greece	CLK	Clark, Phillipines
AVO	Aviano, Italy	CLO	Coltano, Italy
BAH	Bahrain, Bahrain	CMC	C.M.C., Colorado
BAN	Bonn, Germany	CRO	Croughton, England
BDK	Badkreuznach, Germany	DAG	Elmiadag, Turkey
BDM	Bad Muender, Germany	DIC	Dye 5, Iceland
BFM	Botleyhill, England	DIY	Diyarbakir, Turkey
BIG	Bitburg, Germany	DON	Donnersburg, Germany
BLN	Berlin, Germany	DOV	Dover-Foxcroft, Maine
BNT	Bentwaters, England	DRA	Dranesville, Virginia
BRE	Brewton, Alabama	DST	Darmstadt, Germany
BRN	Bremerhaven, Germany	ELE	Elevsis, Greece
BRY	Barkway, England	ELL	Ellisville, Florida
BTL	Brieitsol, Germany	EDZ	Edzell, Scotland
BUC	Ft. Buckner, Okinawa	FEL	Feldburg, Germany
CED	Cedar Brook, New Jersey	FIN	Finegayan, Guam

Table 2.2.2-2. Locations and Abbreviations (Continued)

Abbreviation	Location	Abbreviation	Location
FKT	Frankfurt, Germany	JUL	Julian, California
FLO	Flobecq, Belgium	KAD	Kadota, Japan
FRE	Fredericton, New Brunswick	KAR	Karamursel, Turkey
FTD	Ft. Dietrich, Maryland	KEF	Keflavik, Iceland
FUC	Fuchu, Japan	KEN	Kenitra, Morocco
FYL	Flying Dales Moor, Scotland	KLN	Kaiserlautern, Germany
GAB	Gablingm, Germany	KRE	Karlsruhr, Germany
GSN	Giessen, Germany	KSL	Koenigstuhl, Germany
HAG	Hagerstown, Maryland	KTS	Karatas, Turkey
HAN	Hahn, Germany	LAH	Lakenheath, England
HDG	Heidelburg, Germany	LAM	Lamar, Colorado
HEL	Helena, Montana	LDL	Landstuhl, Germany
HIN	Hillingdon, England	LDN	London, England
HPG	Hohenpieissenberg, Germany	LDR	Londonderry, North Ireland
HST	Hohenstadt, Germany	LEE	Leesburg, Virginia
HUM	Humosa, Spain	LEG	Leghorn, Italy
HYE	High Wycombe, England	LKF	Landerkopf, Germany
INC	Incirlik, Turkey	LIT	Littleton, Massachusetts
IRK	Iraklion, Crete	LOD	Lodi, California
IZM	Izmir, Turkey	LUA	Lua-Lua-Lei, Hawaii
JAS	Jasper, Alabama	LSY	Lindsey, Germany

Table 2.2.2-2. Locations and Abbreviations (Continued)

Abbreviation	Location	Abbreviation	Location
LYO	Lyons, Nebraska	MUL	Muhl, Germany
MAG	St. Mawgan, England	NBG	Nuernberg, Germany
MAM	Martlesham Heath, England	NMK	Nea Marri, Greece
MBA	Mount Limbara, Italy	NPS	Naples, Italy
MCA	Mount Corna, Italy	NTG	Netcong, New Jersey
MEL	Melbourne, Florida	OAK	Oakhanger, England
MEM	Memphis Junction, Arkansas	PAT	Mount Pateras, Greece
MHN	Manheim, Germany	PHR	Pearl Harbor, Hawaii
MIL	Mildenhall, England	PMS	Pirmasens, Germany
MIS	Misawa, Japan	POL	Polk City, Florida
MNH	Munich, Germany	POT	Pottstown, Pennsylvania
MOH	Mormond Hill, Scotland	PRU	Pruem, Germany
MOJ	Mojave, California	RAG	Reese-Augsburg, Germany
MOR	Moron, Spain	REG	Reggio, Italy
MOS	Mosely, Virginia	RMN	Rhein Main, Germany
MOU	Mounds, Oklahoma	RPS	Ruppertsweiller, Germany
MPR	Mount Parnis, Greece	RSN	Ramstein, Germany
MRA	Martina, France	RTA	Rota, Spain
MRE	Mount Vergine, Italy	SAH	Sahin Tepesi, Turkey
MSR	Massweiler Cave, Germany	SCH	Schoenfeld, Germany
MTE	Mount Venda, Italy	SEG	Seguin, Texas

Table 2.2.2-2. Locations and Abbreviations (Continued)

Abbreviation	Location	Abbreviation	Location
SEH	Sembach, Germany	TLY	Tully, New York
SEO	Seoul, Korea	TOL	Toledo Junction, Ohio
SGA	Sigon Ella, Italy	TPF	Tempelhof, Germany
SGT	Stuttgart, Germany	TUS	Thurso, Scotland
SHE	Sherbrooke, Quebec	UHD	Upper Heyford, England
SLO	San Luis Obispo, California	VCA	Vicenza, Italy
SMF	Smith Falls, Ontario	VHN	Vaihingen, Germany
SNP	Sinop, Turkey	WAH	Wahiawa, Hawaii
SNV	San Vito Dei Normanni, Italy	WBG	Wurzburg, Germany
SOC	Socorro, New Mexico	WIL	Williamsburg, Kentucky
SPB	Shape, Belgium	WMS	Worms, Germany
SPM	Spangdahliem, Germany	WSE	Wasserkuppe, Germany
STK	Stockton, California	WTH	Wethersfield, England
STN	Stanfield, North Carolina	WTL	Whitehall, England
STV	Stevens Point, Wisconsin	WYO	Wyoming, Minnesota
SWE	Sweetwater, Texas	YAM	Yamanlartropo, Turkey
SWN	Schwetzingen, Germany	YKS	Yokusuka, Japan
SYH	Sidi Yahia, Morocco	YOK	Yokahama, Japan
TAP	Taipei, Taiwan	ZBN	Zweibrucken, Germany
THL	Thule, Greenland	ZUG	Zugspitze, Germany
TJN	Torrejon, Spain		

When possible, access loops were established to the most remote access locations since the network coverage could not be as complete as that achieved with IST loops. Thus, Ankara, Turkey; Iraklion, Crete; Sidi Yahia, Morocco; Berlin, Germany; Londonderry, North Ireland and Dye 5 in Iceland were chosen for testing. In all, tests were conducted to 33 of the 122 different access locations involved in the network. Of the 77 microwave links used to supply access line channels (exclusive of microwave links in the IST network which also are used for access lines), 34 (46 percent) were transited during the access line tests. Of the 22 tropo links involved, 14 (64 percent) were transited. One of the four diffraction links, one of the five government owned land lines, and one of the two VHF/UHF LOS links were accessed. None of the three leased Telpak circuits were involved. In addition, two calls involved digital links in the FKV project even though these did not appear to be in use for access lines at the time of the tests. This was done since future digitization of the network may require operation over similar channels.

The Pacific IST network as discussed in Appendix A is made up almost exclusively of submarine cables, satellite links and tropo links.

The approach to conducting IST loops in the Pacific was similar to that used in Europe since the Pacific switches also have automatic loop-around capability. In this case secondary routing was accomplished by "busying out" rather than seizing trunks. The resulting set of calls utilized all of the basic links involved in the IST network with the exception of one DSCS hop from the Philippines to Okinawa. It is possible, however, that this link was not in operation at the time of the tests. Of the 16 possible circuit routings between switches, 13 (81 percent) were accessed. Two of the three not accessed involved the DSCS link from the Philippines to Okinawa.

Table 2.2.2-3 shows the 16 circuit routes involved with the Pacific IST network and the number of different circuits and calls placed on each during the testing. As can be seen, 24 of the 155 circuits (15 percent) were used.

Table 2.2.2-3. Pacific Interswitch Circuit Routes

	Type of Link	No. of V1 Circuits	No. of S3 Circuits	Total	No. of Circuits	No. of Calls
BUC-FUC	TROPO + MICROWAVE	2	26	28	-	3
BUC-WAH	DSCS	0	9	9	4	6
FUC-WAH	INTELSAT	0	14	14	6	9
FUC-WAH	TRANS PAC CABLE	0	6	6	1	1
FIN-FUC	TRANS PAC CABLE	0	8	8	-	2
FIN-WAH	TRANS PAC CABLE	0	6	6	2	2
FIN-WAH	INTELSAT	0	6	6	1	1
FIN-WAH	DSCS	0	12	12	4	4
CLA-BUC	TROPO + CABLE + MICR	0	14	14	-	2
CLA-WAH	INTELSAT	0	11	11	1	1
CLA-WAH	TRANS PAC CABLE	0	4	4	1	2
CLA-FUC	TROPO - CABLE - TROPO	0	6	6	0	0
CLA-WAH	DSCS	0	10	10	3	4
CLA-FIN	SUB CABLE	0	12	12	1	1
CLA-FUC	DSCS-TROPO	0	3	3	0	0
CLA-BUC	DSCS	0	6	6	0	0
	Totals	2	153	155	24	38

Information on the number of access lines involved in the Pacific network was not available. However, the approach used to select access lines in the Pacific was to use those presently associated with secure voice manual switchboards (SECORDS). There are 18 such boards in the Pacific, and nine of the 18 were accessed. Loops to the remaining nine were attempted but problems either in the switchboard or in the verbal communications involved prevented the establishment of the loop-around. Taiwan and Korea were among the locations successfully accessed.

Coverage of the trans-Atlantic calls was as complete as it could be made from Hillingdon, England in that 26 of the 27 circuits from Hillingdon to CONUS were tested. The remaining circuit was down at the time of testing. The 26 circuits tested represents 30 percent of the total trans-Atlantic circuits from CONUS to Europe. The remaining 58 circuits not tested connect Feldberg and Mt. Vergine to the CONUS. At the time of the tests the Atlantic DSCS satellite was inoperative. It is assumed, but not confirmed, that calls normally routed through the DSCS were transmitted through the NATO satellite instead. In addition to the NATO satellite, INTELSAT circuits and four undersea cable circuits are used. In fact, 71 of the 85 trans-Atlantic circuits are routed commercially. The calls from Hillingdon transited all of the undersea cables and satellites used in the trans-Atlantic circuits. Table 2.2.2-4 shows the trans-Atlantic circuits and those accessed during the test. (TAT I, III, IV and V are submarine cables.)

The trans-Pacific tests were less complete than the trans-Atlantic tests partially due to the larger number of circuits from Hawaii to CONUS. Of the 55 circuits from Hawaii to CONUS, 19 (34 percent) of them were involved in the test. These circuits did transit all three undersea cables involved but did not access any of the DSCS channels. The routings not accessed carry 6 of the 55 circuits. In addition to the Hawaii-CONUS circuits, there are 13 circuits which connect CONUS to Japan and the Philippines. These circuits are all satellite circuits using either DSCS or INTELSAT satellites. The performance on these circuits should not differ from those from Hawaii using the same satellite. Table 2.2.2-5 shows all the trans-Pacific circuits, as well as

Table 2.2.2-4. Trans-Atlantic Circuits

From	To	Trunk	V2	S3	TOT	No. of Circuits	No. of Calls	Type of Transmission
HIN	PTN	14VS01	2	0	2	2	2	NATO SAT
HIN	CDB	14VS01	3	0	3	2	3	NATO SAT
HIN	PTN	134801	1	0	1	1	1	NATO SAT
HIN	CDB	134801	i	0	1	1	1	NATO SAT
HIN	PTN	137S02	0	4	4	4	5	INTELSAT
HIN	CDB	137S02	0	5	5	5	5	INTELSAT
HIN	PTN	137Q01	0	3	3	3	3	TAT III
HIN	CDB	137Q01	0	5	5	5	5	TAT III
HIN	PTN	157Q01	0	1	1	1	2	TAT V
HIN	CDB	157Q01	0	1	1	1	2	TAT V
HIN	PTD	237Q02	0	1	1	1	1	TAT I
FEL	PTN	14CS01	6	0	6	0	0	NATO SAT
FEL	CDB	14CS01	4	0	4	0	0	NATO SAT
FEL	PTN	147S03	0	14	14	0	0	INTELSAT
FEL	CDB	147S03	0	12	12	0	0	INTELSAT
FEL	PTN	144801	1	0	1	1	1	NATO SAT
FEL	PTN	140S01	1	0	1	0	0	NATO SAT

Table 2.2.2-4. Trans-Atlantic Circuits (Continued)

From	To	Trunk	V2	S3	TOT	No. of Circuits	No. of Calls	Type of Transmission
FEL	CDB	140S01	2	0	2	0	0	NATO SAT
FEL	CDB	14D	0	1	1	0	0	COM
FEL	PTN	137Q01	0	1	1	0	0	TAT III
FEL	CDB	137Q01	0	2	2	0	0	TAT III
FEL	PTN	157Q01	0	1	1	0	0	TAT V
FEL	CDB	144801	1	0	1	0	0	NATO SAT
FEL	CDB	157Q01	0	2	2	0	0	TAT V
FEL	PTN	147Q02	0	1	1	1	1	TAT IV
MRE	PTN	157Q01	0	1	1	0	0	TAT V
MRE	CDB	157S01	0	5	5	0	0	TAT V
MRE	CDB	157Q01	0	3	3	0	0	TAT V
			22	63	85	28	32	

Table 2.2.2-5. Trans-Pacific Circuits

Location	Trunk	V2	S3	TOT	Circuits	Calls	Type of Transmission
LOD-WAH	187Q03	0	6	6	2	2	Hawaii III Cable
SLO-WAH	187Q03	0	7	7	6	8	Hawaii III Cable
LOD-WAH	187Q01	2	1	3	2	2	Hawaii I Cable
LOD-WAH	187Q02	3	1	4	0	0	Hawaii II Cable
SLO-WAH	187Q02	0	3	3	2	2	Hawaii II Cable
LOD-WAH	18FS01	0	3	3	0	0	DSCS
SLO-WAH	18FS01	0	3	3	0	0	DSCS
LOD-WAH	18DV02	2	10	12	5	6	INTELSAT
SLO-WAH	18DV01	0	12	12	2	2	INTELSAT
LOD-WAH	187S01	0	2	2	0	0	INTELSAT
LOD-WAH	187S04	0	1	1	0	0	INTELSAT
Subtotal		7	49	56	19	22	
LOD-FUC	177S02	0	4	4	0	0	INTELSAT
SLO-FUC	177S02	0	2	2	0	0	INTELSAT
LOD-CLK	177S01	0	3	3	0	0	INTELSAT
SLO-CLK	177S01	0	2	2	0	0	INTELSAT
LOD-CLK	17CS02	0	1	1	0	0	DSCS
LOD-CLK	17CS02	0	1	1	0	0	DSCS
Subtotal		0	13	13	0	0	
Totals		7	62	69	19	22	

those accessed during the tests. The totals are shown for those circuits from Hawaii and those from Japan and the Philippines.

The coverage of CONUS was limited to loop-around calls made to 39 different CONUS AUTOVON switches from Melbourne, Florida. These calls were made from each of two AUTOVON phones which are connected to access lines from the Polk City, Florida switch. The 29 loop-around locations represented all of the loop-arounds that could be located in the CONUS network.

2.2.3 One-Way Versus Looped BER

To obtain the network coverage described in the previous section, it was necessary to rely heavily on loop around calls. In order to obtain a rough correlation between the bit error rates of a one-way call and a loop-around call, most of the circuits used for one way calls were also tested in a loop-around configuration immediately following the measurement of the one-way data. This data was taken on European IST, trans-Atlantic and trans-Pacific calls. In all, 17 European IST calls, 32 trans-Atlantic calls and 17 trans-Pacific calls fell in this category. Tables 2.2.3-1, 2.2.3-2, and 2.2.3-3 show the bit error rates obtained in the one-way and looped calls. Figure 2.2.3 is a plot of the one-way versus the looped error rates on calls where the looped error rate is 10^{-3} or higher. The dotted line represents a boundary which all calls equaled or bettered; thus, it should represent a conservative conversion factor between looped and one-way error rates. As can be seen, a looped error rate of approximately 6 percent corresponds to 1 percent one-way error rate while a looped error rate of 8 percent and 11 percent correspond to a one-way error rate of 2 percent and 5 percent respectively. Although no guarantee exists that the ratio of one-way error rates to looped error rate will always be as high as that shown in the curve of Figure 2.2.3, there is strong evidence to indicate that the ratio will often be higher.

Table 2.2.3-1. European IST One-Way Versus Looped BER

One-Way Call No.	Looped Call No.	One-Way BER	Looped BER
38	39	7.00E-6	9.91E-4
135	136	0	3.75E-6
40	41	5.91E-3	5.37E-2
44	45	1.11E-4	1.89E-2
42	43	5.91E-4	5.52E-4
46	47	2.48E-3	1.32E-2
50	51	8.05E-4	8.07E-4
52	53	8.74E-4	8.47E-4
76	77	6.25E-6	0
78	79	5.25E-5	3.06E-4
129	130	1.01E-3	2.44E-3
80	81	1.08E-3	2.23E-2
133	134	6.96E-3	1.99E-2
153	154	2.96E-4	1.25E-2
151	152	1.07E-2	6.23E-2
131	132	4.51E-2	1.18E-1
155	156	4.56E-4	5.03E-3

Table 2.2.3-2. Trans-Atlantic One-Way Versus Looped BER

One-Way Call No.	Looped Call No.	One-Way BER	Two-Way BER
222	223	6.39E-3	2.04E-1
210	211	4.46E-3	1.92E-1
186	187	4.02E-3	2.37E-1
188	189	2.40E-2	1.87E-1
248	249	4.87E-3	2.44E-1
224	225	2.62E-3	2.66E-1
244	245	1.30E-2	2.44E-1
214	215	2.37E-2	1.51E-1
242	243	1.61E-2	1.02E-1
220	221	1.33E-2	1.34E-1
204	205	3.39E-3	8.99E-2
236	237	1.14E-2	9.34E-2
212	213	1.82E-3	3.71E-2
216	217	1.34E-2	1.29E-1
202	203	2.48E-3	7.49E-2
229	230	2.47E-4	3.67E-2
190	191	3.23E-4	3.22E-2
227	228	3.35E-4	4.13E-2
192	193	7.10E-4	3.82E-2
200	201	2.94E-3	4.08E-2

Table 2.2.3-2. Trans-Atlantic One-Way Versus Looped BER (Continued)

One-Way Call No.	Looped Call No.	One-Way BER	Two-Way BER
194	195	5.22E-3	4.80E-2
232	233	1.06E-2	1.11E-1
240	241	3.41E-2	1.40E-1
246	247	7.75E-3	1.84E-1
208	209	4.05E-3	5.28E-2
231	232	1.65E-3	1.06E-2
234	235	5.92E-3	8.50E-2
206	207	1.12E-3	3.48E-2
238	239	6.54E-4	3.39E-2
198	199	4.24E-4	1.97E-2
216	217	1.34E-2	1.29E-1
196	197	1.73E-3	4.25E-2

Table 2.2.3-3. Trans-Pacific One-Way Versus Looped BER

One-Way Call No.	Looped Call No.	One-Way BER	Looped BER
285	286	1.19E-4	8.76E-3
287	288	2.11E-4	3.02E-2
302	303	1.68E-3	6.29E-2
319	320	8.90E-4	5.74E-2
323	324	2.66E-4	1.05E-2
289	290	1.87E-5	4.47E-3
309	310	6.62E-4	5.39E-3
321	322	9.12E-5	9.38E-3
330	331	5.00E-6	4.97E-3
335	336	3.00E-5	8.81E-3
298	299	1.74E-4	1.45E-2
304	305	5.24E-4	5.04E-3
317	318	5.25E-5	3.60E-3
267	268	6.37E-5	4.38E-3
300	301	2.25E-5	3.78E-3
337	338	5.67E-3	2.01E-2
269	270	1.29E-4	1.53E-2

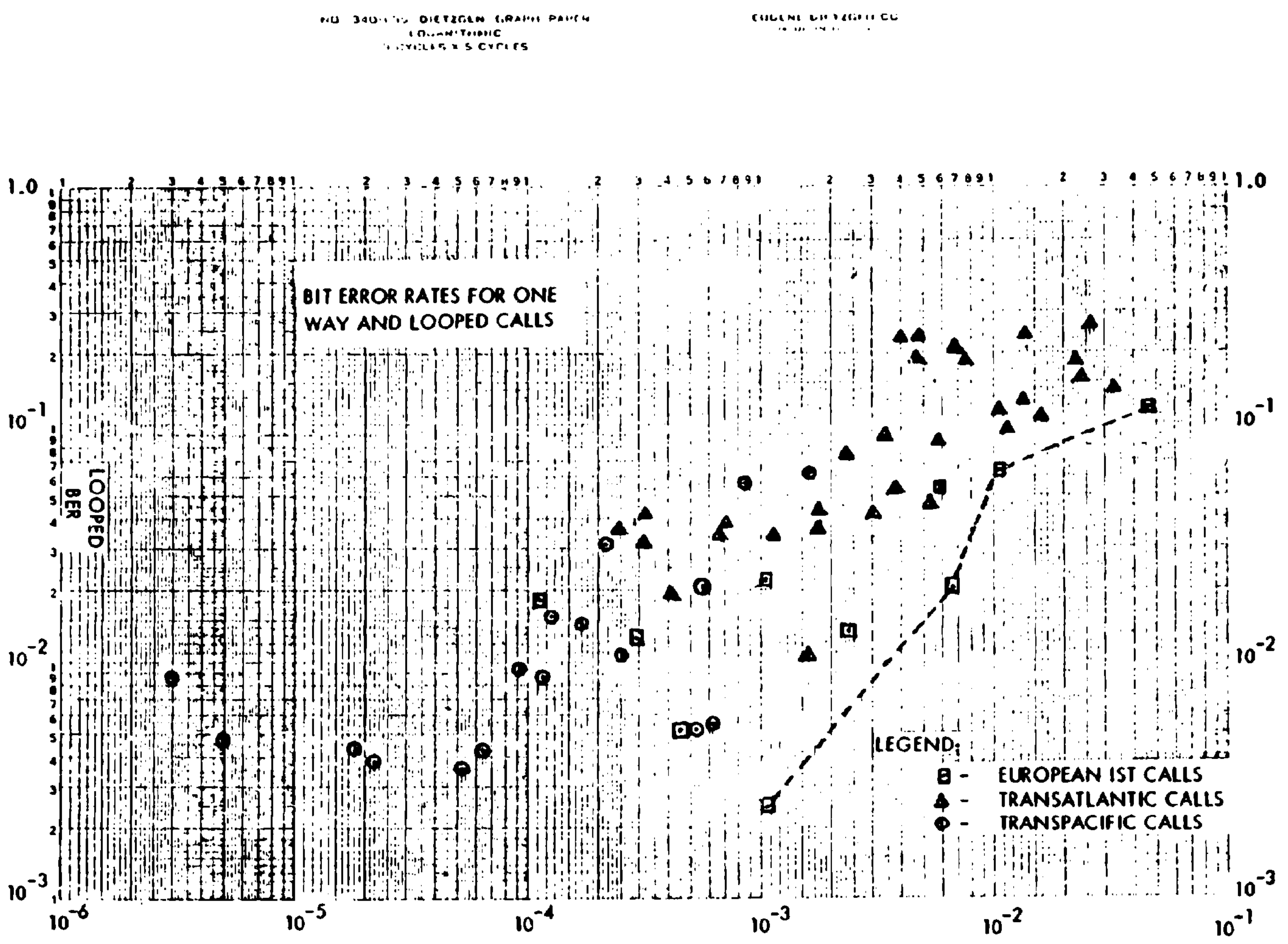


Figure 2.2.3. One-Way BER

It is interesting to note that in virtually all cases all of the line parameters associated with the loop-around calls were degraded over the same parameters associated with one-way calls. The exception to this was frequency offset which was inevitably zero for loop-arounds but generally non-zero for one-way calls. The modem BER, however, is reasonably insensitive to this parameter as long as it is less than 10 Hz. The largest frequency offset observed on a one-way call was 4 Hz. Phase jitter, which might be expected to be less for loop-around calls, usually increased for the loop-around configuration and was rarely less. Perhaps the explanation for this is that the rate of jitter is fast enough and the delay in the channel long enough to make the jitter in the receive and transmit channels of the multiplexer relatively independent.

2.2.4 Composite Network Considerations

The tests were configured to obtain modem performance on each segment of the AUTOVON network rather than from Pacific network locations to Atlantic network locations. As discussed in Paragraph 2.2.5, loop-around calls were attempted from Italy to Hawaii and from Hawaii to England on voice grade lines with unsatisfactory results so far as the 16 kb operation was concerned. A one-way call, however, in these instances might have been quite satisfactory. On one of the Hawaii-England calls a 9.6 kb/s modem was placed on the same loop and was unable to operate even though the same type of modem was in operational use for European traffic.

The 2.4 kb modems used in the AUTOSEVOCOM system employ regenerators at the gateway locations. In the Pacific network the regenerators are not used at Wahiawa if the call originates in Oahu, but is employed otherwise. The CONUS regenerators also change the crypto key. Since the regenerators demodulate the line signal to the digital level only and remodulate at that level, the overall bit error rate associated with a call involving two segments connected by a regenerator will be very close to the sum of the bit error rates in each segment.

If regenerators were supplied at each gateway for the 16 kb/s modem a call from a Pacific location to an Atlantic location might involve five segments, Pacific, Trans-Pacific, CONUS, Trans-Atlantic and European. Thus the bit error rate involved in the total call would be the sum of the five individual bit error rates. If the looped error rates are converted to one-way error rates for the Pacific and CONUS segments it can be concluded that satisfactory error rates would likely be available on most worldwide calls on this basis. In consideration of this process, care must be taken not to add the error rates associated with 80 percent values for the individual segments if it is wished to obtain the error rate for 80 percent of the overall lines. The probability that each of five independent segments would have lines corresponding to the 20 percent worst-case lines is only 0.032 percent.

A legitimate question that was unanswered by the tests is whether satisfactory performance could be obtained without some, or perhaps all, of the regenerators. If key change is required in CONUS, regenerators at the CONUS gateways are a necessity regardless of the operational capability of the modem. Regenerators at the overseas gateways might not be necessary, however, and those in CONUS might not be if the key change were not required. Reduction or elimination of the regenerators could reduce the cost of network deployment of the 16 kb modem.

2.2.5 Special Calls

A number of calls were placed that were not included in the data presented in Paragraph 2.2.1. The trans-Atlantic calls and trans-Pacific calls usually involved both one-way and looped measurements. Only the one-way data was presented in Paragraph 2.2.1 since the looped data appeared to be superfluous except for correlating one-way versus looped. The looped as well as the one-way data is included in the tables of Appendix C.

In addition, 30 calls have been included in Table C-10 of Appendix C which do not fit appropriately into one of the nine categories of calls reported upon in Paragraph 2.2.1. Call 257 in Table C-10 was a loop from Pearl Harbor to Wahiawa which ran error free at 16 kb. Since it was the only access call in the Pacific it did not appear to warrant a category of its own.

Call 157 was a configuration arranged in Europe where two access lines and an IST were involved. A loop to Vicenza, Italy, was established in Coltano, Italy. An IST connection was established from Coltano to Hillingdon, England via Humosa and Rota in Spain. A second access loop over leased General Post Office (GPO) lines was established to London from Hillingdon. The transmitted signal was then sent from Coltano to Vicenza, and back to Coltano, to Hillingdon, to London, and back to Hillingdon. The 16 kb error rate of this configuration was 4.25×10^{-3}. A loop established from the modem at Hillingdon through this network produced a 16 kb error rate of 3.80×10^{-2}.

Call 333 in Table C-10 was a loop through a short HF hop on Oahu. The modem was located at Pearl Harbor. The transmitted signal was sent via a leased AUTOVON line to Wahiawa and then to Lua Lua Lei which is located about 15 miles over a mountain from Wahiawa. The signal was then sent via an HF link back to Wahiawa and then via AUTOVON back to Pearl Harbor. The 16 kb error rate was 9.87×10^{-3} over this configuration and the 8 kb configuration was error free. Almost no fading was observed on the signals during the tests. Although these results are interesting, caution should be used in extrapolating to long HF links where the effect of the medium might differ.

Calls 183A and 183B listed in the table involved tests from the Royal Signal and Radar Establishment in Christchurch, England to Whitehall and Oakhanger in England over leased 4-wire lines. This demonstration had been set up during the site survey trip. The 16 kb call to Oakhanger ran error free for the 50 second count and that to Whitehall provided a BER of 5.00×10^{-6}. The call to Oakhanger was left on for a 92 minute period with an average 16 kb error rate of 3.85×10^{-5}.

Calls 250, 217, 251, and 241 in Table C-10 were trans-Atlantic loops which indicated that the access line from the CONUS gateway to Ft. Dietrich, Maryland was a major contributor to the error rates in the trans-Atlantic calls. Loop-around calls to Ft. Dietrich from Hillingdon, England had been placed on known trans-Atlantic circuits through the Cedar Brook, N.J. and Pottstown, Pa. CONUS gateway switches. Loop-arounds to Cedar Brook and Pottstown were then placed using the same trans-Atlantic circuits. In the case of the Cedar Brook circuit, an error rate of 12.9 percent was obtained on the loop around to Ft. Dietrich while an error rate of 1.12 percent was achieved when the circuit was looped at Cedar Brook. A number of the line quality parameters were significantly degraded when the loop was extended to Ft. Dietrich. The harmonic distortion was 3.55 percent looped at Ft. Dietrich and 1.15 percent looped at Cedar Brook. In the case of the Pottstown circuit, an error rate of 14.0 percent was obtained looped at Ft. Dietrich while an error rate of 7.69 percent was obtained looped at Pottstown. The harmonic distortion was 7.24 percent looped at Ft. Dietrich and 4.28 percent looped at Pottstown. (This line was selected since it was the worst line to Pottstown from Hillingdon.)

Calls 129A and 129B in Table C-10 were loop-around calls to Pottstown from Feldburg, Germany. Call 129A was placed on a V2 conditioned circuit through the NATO satellite and provided a looped 16 kb error rate of 7.77 percent. The equalizer weights on this call were extremely active indicating that the equalizer was stressed in this configuration. This occurrence was also noted on trans-Atlantic loops from Hillingdon involving V2 conditioned lines. Call 129B was another loop to Pottstown from Feldberg on an S3 conditioned line. The 16 kb BER was 2.52×10^{-3} for this call.

Call 306 in Table C-10 was a loop-around call from Pearl Harbor to San Luis Obispo, CA which was placed in an attempt to obtain the same type of calibration of the Stockton, CA access lines as obtained for the Ft. Dietrich lines. Unfortunately, the trans-Pacific line obtained in this call was not used in any of the Stockton calls so that a direct comparison could not be made. A looped error rate of 1.02×10^{-3} was obtained, however, which was slightly better than the best looped error rate to Stockton. Calls 307 and 326 provide a slightly better comparison. Call 307 was a loop to the CONUS switch at Mojave, CA through a trans-Pacific circuit to San Luis Obispo on the Hawaii III cable. Call 326 was a loop to Stockton on the same trans-Pacific line. The loop to Mojave provided a 16 kb BER of 1.93×10^{-3} while the loop to Stockton on the same trans-Pacific circuit had a 16 kb BER of 1.32×10^{-2}. Thus it appears likely that the access lines to Stockton also may have adversely affected the BER measurements relative to measurements taken directly at the CONUS gateway switches. The BER values to Stockton, however, were good enough to make this conjecture academic in nature.

Calls 111 and 127 in Table C-10 are European IST loops from Feldberg, Germany which provided identical 16 kb BER values of 2.82 percent. These calls were supposed to have been placed to the Martlesham-Heath loop-around number from Feldberg through the switch at Donnersburg, Germany to provide measurements on the secondary routing from Feldberg to Martlesham-Heath. Patient tracing of the

connections, however, indicated that they were not looped at Martlesham-Heath. The second connection was traced as far as Mt. Vergine, Italy but was not observed leaving there which probably implies that the loop-around on both calls was made at Mt. Vergine through Donnersburg for some reason. Since the routing was felt to be somewhat in doubt due to these events these calls were relegated to Table C-10 rather than Table C-1 which contains the normal IST looped calls. The next day a legitimate loop to Martlesham Heath from Feldberg through Donnersburg was established which yielded a 16 kb BER of 7.72×10^{-4}. It is interesting to note that the secondary routing call from Feldberg to Mount Vergine does go through the Donnersburg switch and an error rate of 2.20 percent was obtained on that call.

Call 49 in Table C-10 was from Hillingdon to Coltano which provided a BER of 1.50×10^{-5} but the circuit was lost before any routing information was obtained.

Calls 11, 15, and 16 were placed from Coltano, Italy to evaluate the effect of establishing loop-around connections at access locations at a two-wire rather than four-wire point. The first of these to Leghorn was made on an automatic dialed basis. (This service is being established for several access locations from Coltano.) Although the 16 kb BER was 7.50×10^{-6} with the two wire loops, the four-wire loops at Leghorn had been error free. Calls 15 and 16 were two-wire loops established by the PBX operator in Ankara, Turkey. The 16 kb BER values for these calls were 2.85×10^{-1} and 3.65×10^{-2}. Four-wire loops to Ankara from Coltano provided BER values of 5.36×10^{-3} and 1.26×10^{-2}. Further, the equalizer weight patterns observed on the two-wire loops indicated considerable reflections on the line which were likely caused by mismatch at the looped connection point. These measurements indicated that even though two-wire loops might be somewhat easier to establish, four-wire loops should be used to obtain representative data.

Calls 334 and 69A were loops established from Pearl Harbor, Hawaii to Hillingdon, England and from Coltano, Italy to Wahiawa, Hawaii

respectively. The 16 kb BER values of these calls was 12.5 percent and 18.1 percent, which would be totally unacceptable from a user standpoint. Both calls were placed on voice grade circuits since data grade calls automatically inserted regenerators which could not operate with the 16 kb modem. Whether one way calls and/or the use of data grade lines would have provided acceptable error rates is a matter of conjecture. The calls were placed to obtain some rough feeling for worldwide performance since the overall test plan was not designed for direct measurement of this mode of operation. Had the looped values been better, the question in this direction would have been answered. However, the values obtained were such that no conclusions can be drawn. It is interesting to note that on the loop to England from Hawaii the 8 kb BER value was 4.11×10^{-4} while an operational 9.6 kb modem was unable to operate over the same loop. The 8 kb BER value on the loop from Italy to Hawaii was 1.34×10^{-2}.

The last seven calls in Table C-10 were calls in which the lines appeared to be degraded by in-band filters of some sort. The most common of these was a notch at 2.6 kHz which indicated the insertion of a single frequency (SF) filter used to handle the off hook signal. In addition, several lines indicated notches at 1600 Hz which apparently come from filters associated with a different signaling aspect. Some thought was given, in the course of preparing this report, as to whether these calls should be counted in the statistics given in Paragraph 2.2.1. Since the number of calls involved is small and the errors were not necessarily catastrophic, the effect on the statistics would not be very dramatic. However, it was reasoned that most, if not all, of these cases were either transient in nature (that is a line so bad that it would be complained about and fixed) or was due to the attempt to operate data signals over the voice grade network when no alignment of that network for this purpose had been done. Specifically the detection levels of the circuitry which inserts the SF filters was likely to be quite satisfactory to prevent their insertion due to normal voice traffic but not satisfactory for a data signal which has different spectral properties. They can be adjusted, as they undoubtedly are, for data grade lines, to also be satisfactory for data signals

but there has been no requirement to do so. If a decision were made that allowed data signals on voice grade lines on an operational basis the readjustments would be required as a matter of course and the problem would disappear. Hence, these calls were not considered representative of the network and were relegated to Table C-10.

For the purposes of completeness, it will be noted that 13 data sheets used during the test program contained some recorded data that is not included in the report. These sheets contained data for calls that involved setups that were discovered to be faulty in some manner such as; abnormal levels due to a mistake in patch locations, use of bad equipment to reach the transmitter or modem location from the switchboard, etc. To assure a fair presentation when the data was reduced, all data sheets containing any data were preserved during the tests and these sheets occupy a number in the chronological listing of the call numbers.

2.3 Line Test Results

Curves are presented in this section showing the percentage of channels providing specified line characteristics with values equal to or less than the ordinate or abscissa of the curve in question. The data is subdivided into the nine categories of calls presented in Paragraph 2.2.1 for the modem performance data. The three curves representing performance on the Pacific, European and CONUS IST loops are presented together. The one-way calls on the European, trans-Atlantic and trans-Pacific calls are also presented together as are the three categories of access line loops (European access loops, European remote access loops and Pacific remote access loops). In Appendix C the measured line characteristics for each call are listed along with the error rate performance.

Before presenting the data, several general comments are appropriate. All of the line data was obtained using a model 520 B Halcyon line tester. Details of the test procedure are given in Paragraph 2.4. The phase detector used in the Halcyon to provide measurements of peak-to-peak phase jitter does not respond to very low frequency jitter. In several instances large amounts of very low frequency phase jitter was observed on the tones appearing on the oscilloscope but the Halcyon indicated low phase jitter readings. Since the modem performance is relatively insensitive to low frequency phase jitter, this feature of the Halcyon is not too important. It can, however, account for some difference between values of phase jitter recorded on this test program and those which have been recorded in past programs where this parameter was measured with different equipment.

Differences between the data reported here and that previously gathered might also have occurred when tropo links were involved. In the tests reported herein, the line characteristic values reported were "average values" when a deep fade was not present. When deep fades occured, all of the parameters varied widely. In some channels the variance of the values without deep fades was significant. If past data

values were obtained by reading "peak values" from recorder charts, they might be expected to vary significantly from those obtained on this test.

It should be noted that ordinary line test equipment is not set up to measure the pertinent parameters associated with the fading characteristics when tropo channels are present. Since these characteristics represented one of the two significant error contributors to the 16 kb modem, it would appear prudent to assure that future network models attempt to simulate these effects. No mention of these characteristics was found prior to this test in reports of past measurements.

Oscilloscope photographs of the envelope of a 1 kHz sinewave were made on many of the tropo transmissions and are included in Appendix D. Table 2.3-1 lists the peak-to-peak amplitude variation observed in these pictures as a percent of the peak-to-peak signal. The "period" shown in the table indicates roughly the time between successive fades and does not imply that fading is necessarily periodic. In many cases the period of fade was not clear from the photographs and is indicated with a dash in the table.

A third cause of difference in the line characteristics measured in this test and those measured previously is the difference in routing between test programs. In the present program much of the data is loop-around data, whereas most of the past data is one-way. Even in the case of one-way data, the routings involved in this test do not correspond exactly to those present in past tests. In the program which evaluated the Vodat modem, all of the IST calls were conducted from Mt. Pateras to Hillingdon which involved tropo on all calls.

Finally it is probable that the European network has been improved since the last tests were conducted. Several operational personnel who had been with the network for some time felt that the present quality control programs for assuring line quality have significantly improved the lines.

There were 14 different types of line measurements made, not counting those associated with the amplitude response and group delay of the channels. Figures

Table 2.3-1. Amplitude Variation

Call No.	P-P Amplitude Variation - %	Period of Amplitude
30	6	30 ms
31	6	20 ms
35	28	1.1 sec
37	4	0.45 sec
40	7	1.3 sec
41	9	0.8 sec
41-2	9	—
54	7	—
61	4	0.5 sec
64	6	0.6 sec
66	5	0.5 sec
71	17	2 sec
82	8	40 ms
86-1	7	1.2 sec
86-2	20	>4 sec
92	12	—
107	9	—
111	43	—
126	8	50 ms
127	31	—
129B	—	—

Table 2.3-1. Amplitude Variation (Continued)

Call No.	P-P Amplitude Variation - %	Period of Amplitude
144	20	6 sec
151	11	—
152	22	—
154	12	—
157	6	—
158	11	—
162	9	—
168	9	—
181	9	2 ms
240	21	Distortion
276	9	0.1 sec
292	3	1.5 sec
297	28	Distortion
313	6	20 ms

2.3-1, 2.3-2 and 2.3-3 present the percent of channels with line loss equal to or less than that shown in the abscissa. The line loss was measured both with the modem signal and with a 1 kHz tone and both types of loss are shown. The reason for including both types of measurement is that the modem performance is concerned principally in the loss associated with the modem signal while the standard techniques for determining this parameter is to use a 1 kHz tone. The two differ significantly for some channels due to variations in the amplitude response of the channel. In this report a positive line loss indicates that the received signal is smaller than the transmitted signal. Since all of the calls were essentially from one technical control facility to another, the nominal line loss should be zero.

Figures 2.3-4, 2.3-5, and 2.3-6 present receive S/N ratio data also measured separately with the data signal and with a 1 kHz tone. An additional difference between these two measurements is that in the case of the data S/N ratio, the quiet line noise was used in the ratio. In the case of the 1 kHz S/N ratio the noise level is obtained by notching the 1 kHz tone at the receive site. In this case harmonic distortion contributes to the degradation of the S/N ratio. This accounts for the notic- able difference of the two parameters in the CONUS IST loops. In both cases the n- was measured through a C-message weighted filter provided in the Halcyon.

Figures 2.3-7, 2.3-8, and 2.3-9 present data concerning peak-to- phase jitter. Some of the reasons that this data indicates less phase jitter for the E network than that previously reported have already been given. In addition to thi measurement the spectral characteristics of the phase jitter was obtained on many lines and is presented in Appendix D. The original test plan called for making spectral photographs of phase jitter whenever the peak-to-peak value exceeded 15°. However, so few channels had jitter this large that a number of spectral photographs were obtained for many channels with less than 15° jitter when periodic jitter appeared to be present. Table 2.3-2 shows the size of the periodic components on these photographs. Perhaps the most significant aspect of the phase jitter measurements is the fact that most channels

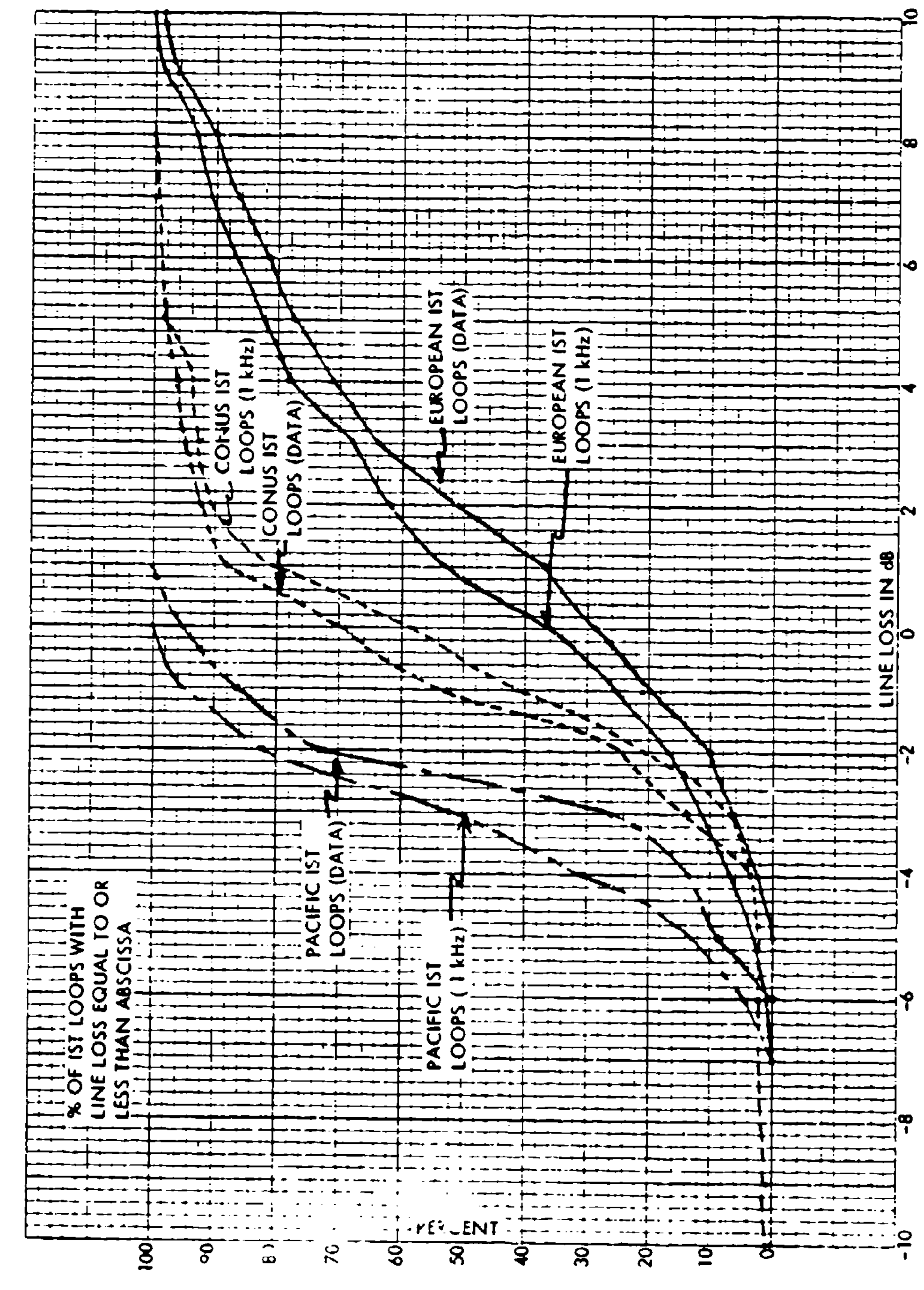

% OF IST LOOPS WITH LINE LOSS EQUAL TO OR LESS THAN ABSCISSA
CONUS IST LOOPS (1 kHz)
CONUS IST LOOPS (DATA)
EUROPEAN IST LOOPS (DATA)
EUROPEAN IST LOOPS (1 kHz)
PACIFIC IST LOOPS (DATA)
PACIFIC IST LOOPS (1 kHz)
LINE LOSS IN dB
100
90
70
60
50
40
30
20
10
0
-10
-8
-6
-4
-2
0
2
4
6
8
10

Figure 2.3-1

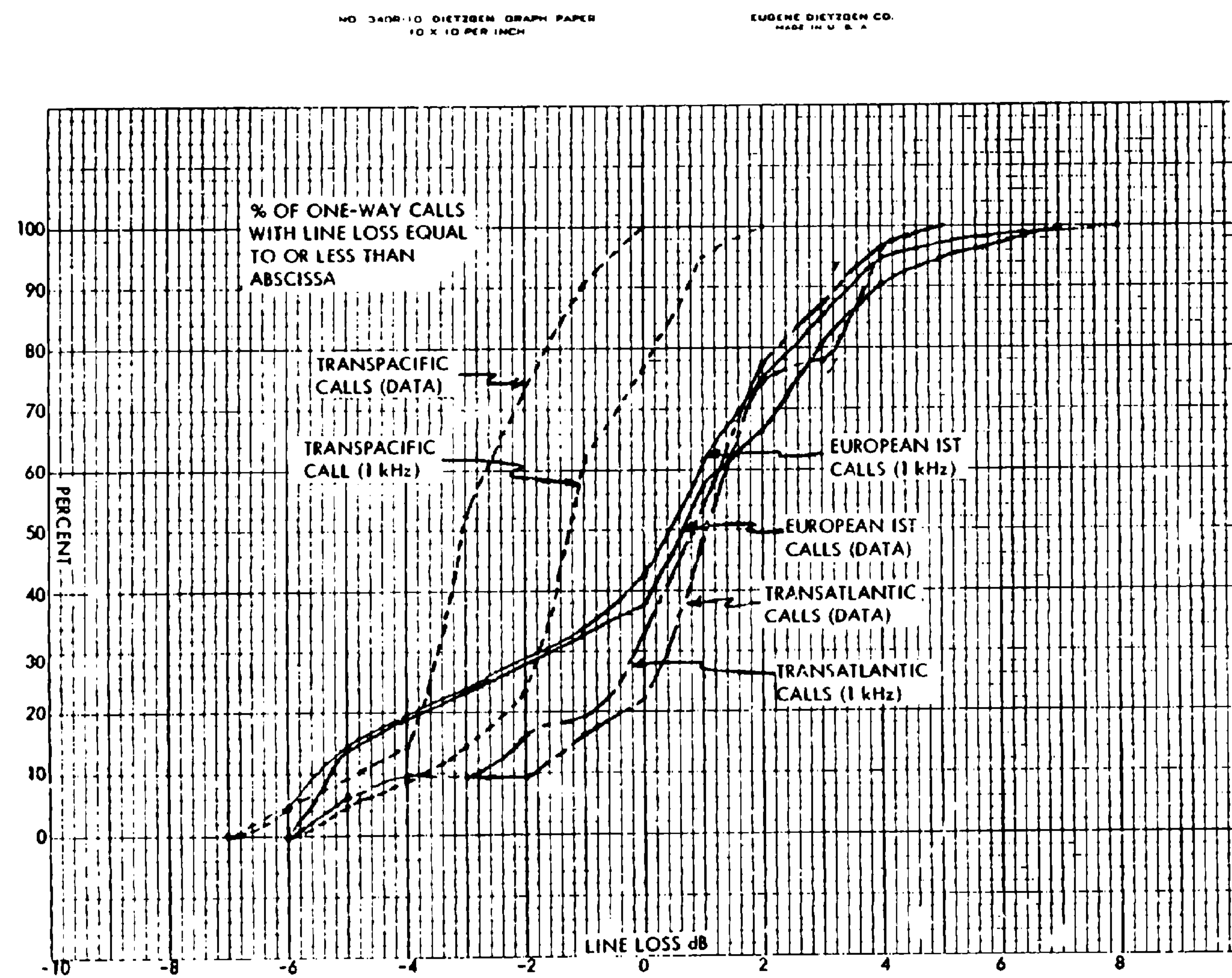
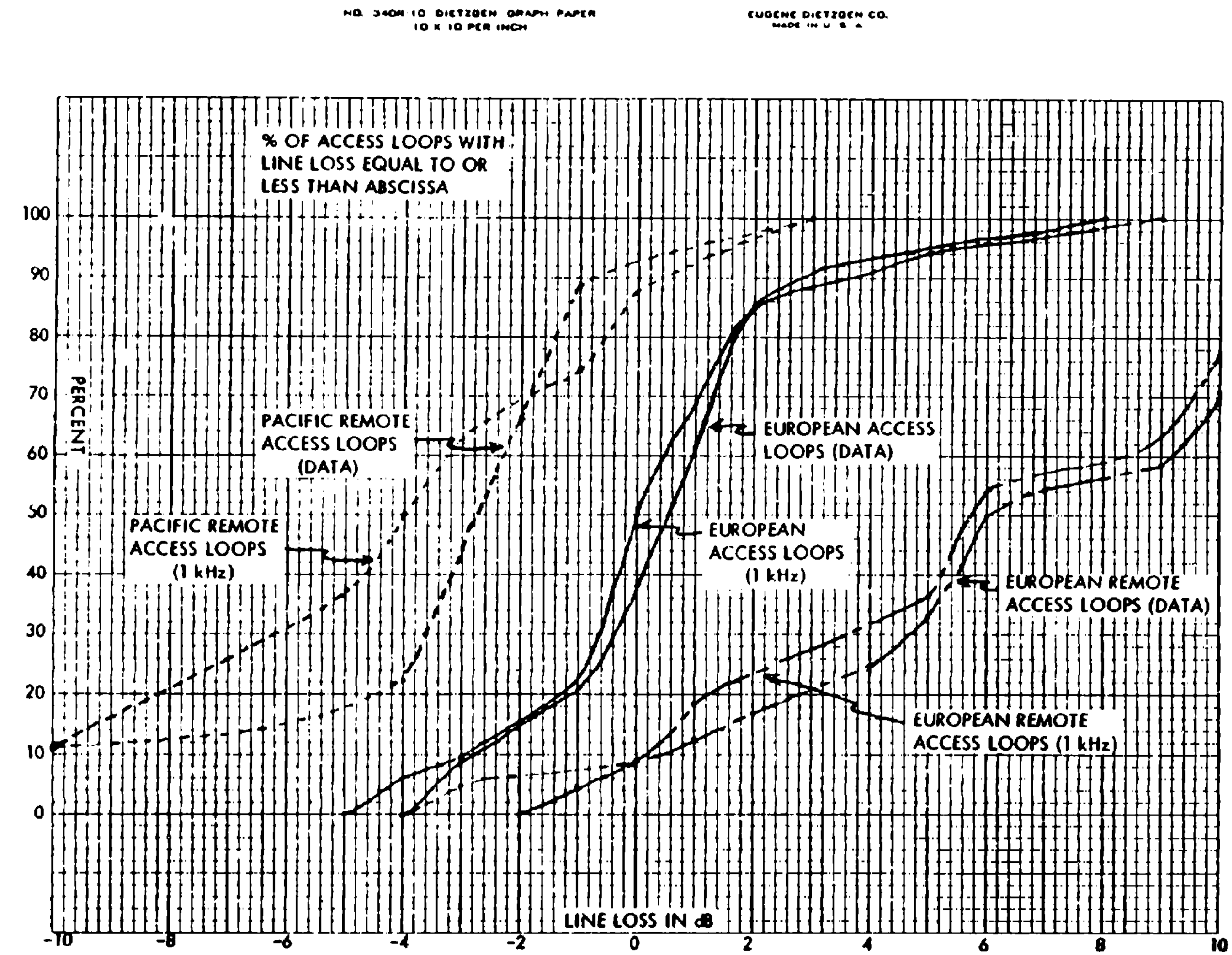

NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.
% OF ONE-WAY CALLS
WITH LINE LOSS EQUAL
TO OR LESS THAN
ABSCISSA
TRANSPACIFIC
CALLS (DATA)
TRANSPACIFIC
CALL (1 kHz)
EUROPEAN IST
CALLS (1 kHz)
EUROPEAN IST
CALLS (DATA)
TRANSATLANTIC
CALLS (DATA)
TRANSATLANTIC
CALLS (1 kHz)
PERCENT
100
90
80
70
60
50
40
30
20
10
0
LINE LOSS dB
-10
-8
-6
-4
-2
0
2
4
6
8
10

Figure 2.3-2



NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.
% OF ACCESS LOOPS WITH LINE LOSS EQUAL TO OR LESS THAN ABSCISSA
PERCENT
100
90
80
70
60
50
40
30
20
10
0
PACIFIC REMOTE ACCESS LOOPS (DATA)
PACIFIC REMOTE ACCESS LOOPS (1 kHz)
EUROPEAN ACCESS LOOPS (DATA)
EUROPEAN ACCESS LOOPS (1 kHz)
EUROPEAN REMOTE ACCESS LOOPS (DATA)
EUROPEAN REMOTE ACCESS LOOPS (1 kHz)
LINE LOSS IN dB
-10
-8
-6
-4
-2
0
2
4
6
8
10

Figure 2.3-3

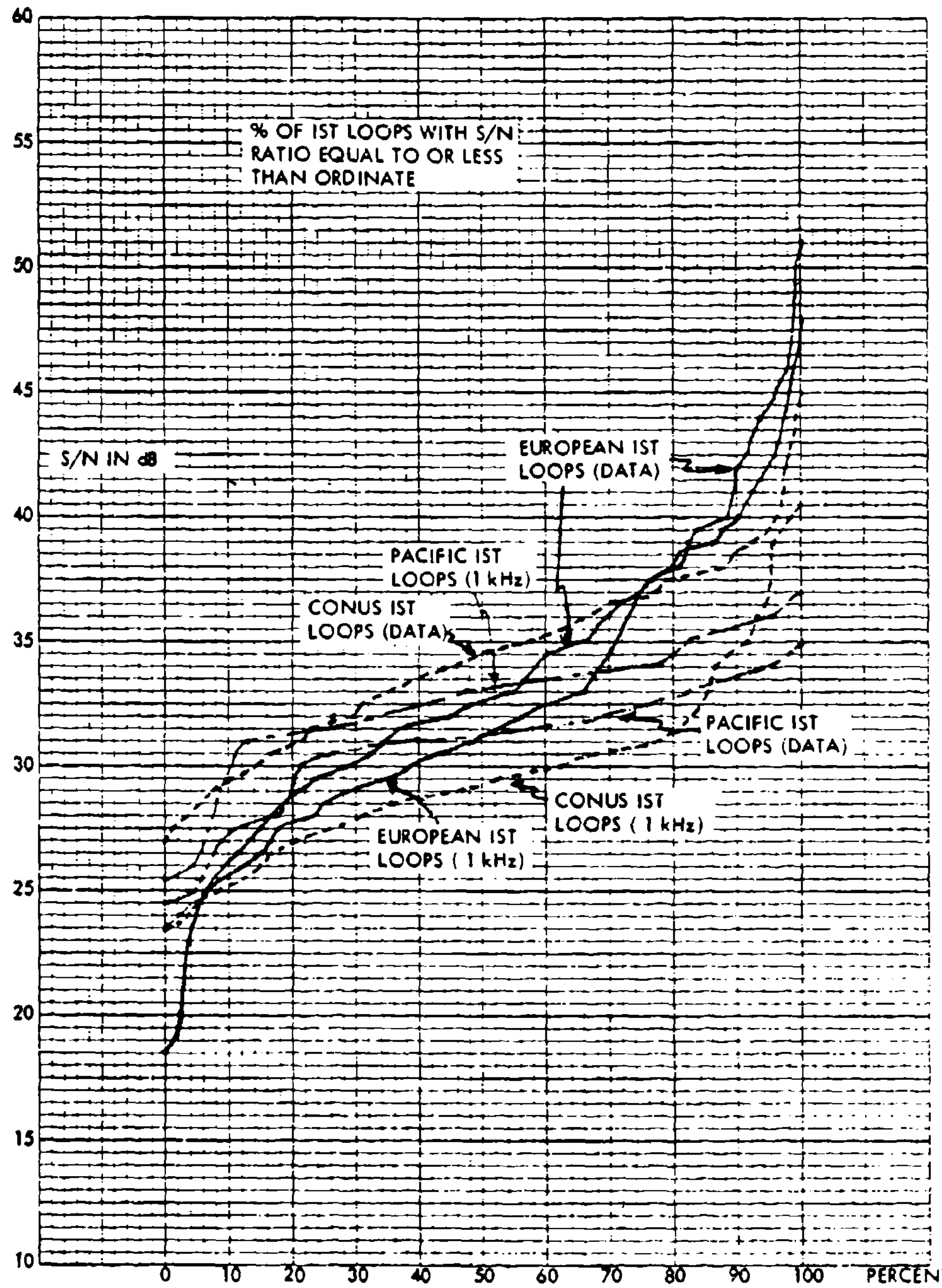

% OF IST LOOPS WITH S/N RATIO EQUAL TO OR LESS THAN ORDINATE
S/N IN dB
EUROPEAN IST LOOPS (DATA)
PACIFIC IST LOOPS (1 kHz)
CONUS IST LOOPS (DATA)
PACIFIC IST LOOPS (DATA)
CONUS IST LOOPS (1 kHz)
EUROPEAN IST LOOPS (1 kHz)
60
55
50
45
40
35
30
25
20
15
10
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-4

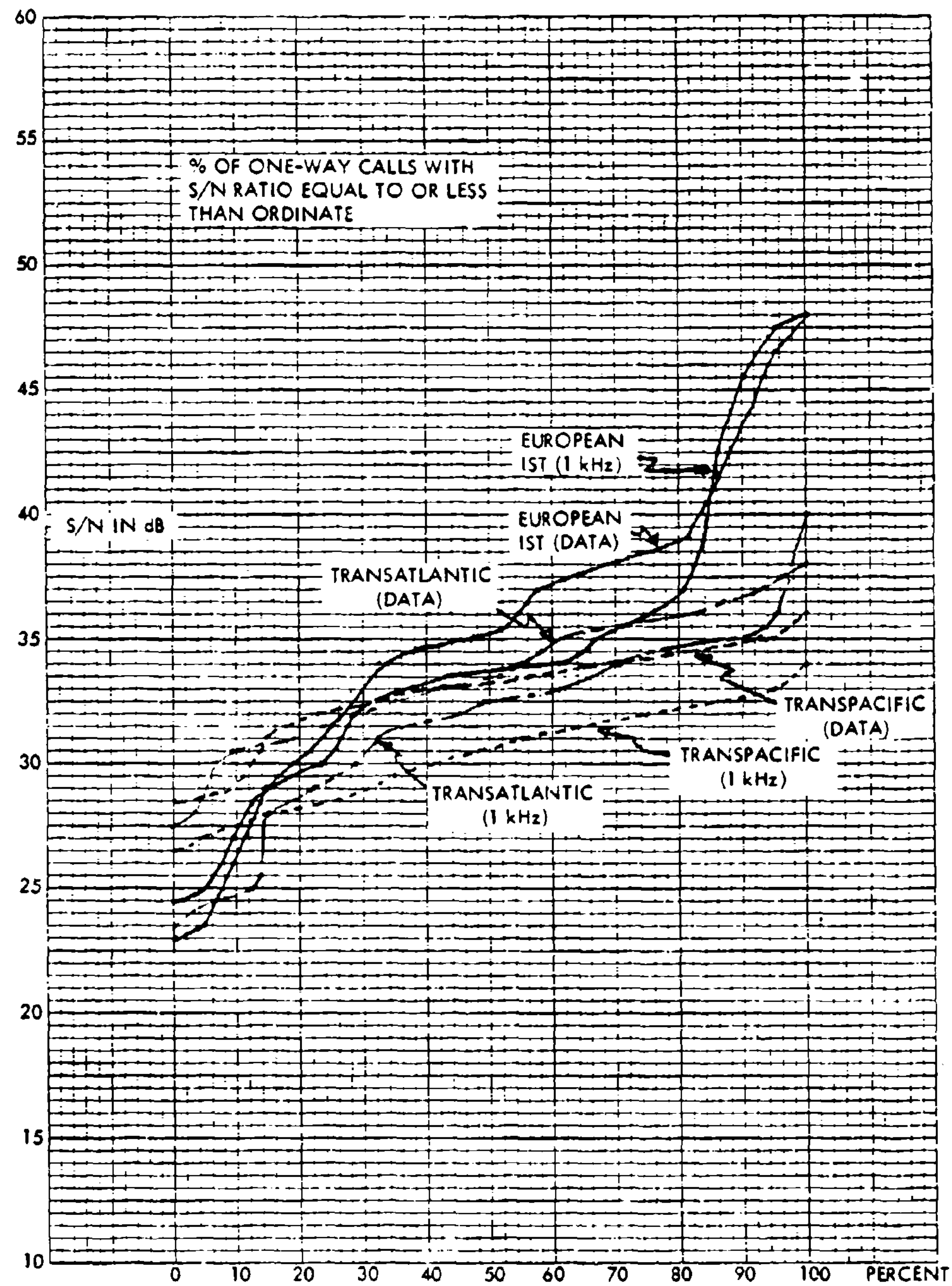

% OF ONE-WAY CALLS WITH
S/N RATIO EQUAL TO OR LESS
THAN ORDINATE
S/N IN dB
EUROPEAN
IST (1 kHz)
EUROPEAN
IST (DATA)
TRANSATLANTIC
(DATA)
TRANSPACIFIC
(DATA)
TRANSPACIFIC
(1 kHz)
TRANSATLANTIC
(1 kHz)
60
55
50
45
40
35
30
25
20
15
10
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-5

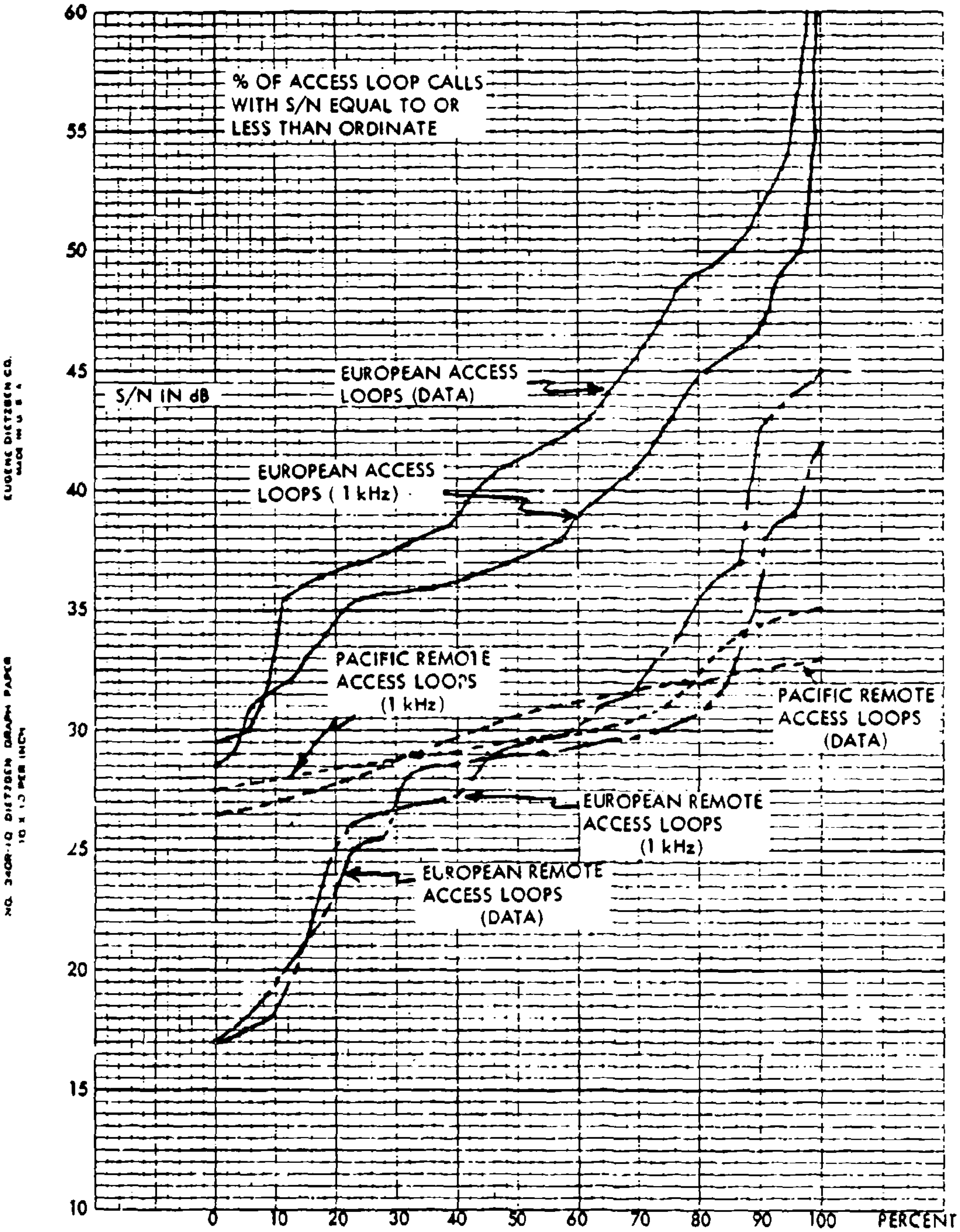

% OF ACCESS LOOP CALLS WITH S/N EQUAL TO OR LESS THAN ORDINATE
S/N IN dB
EUROPEAN ACCESS LOOPS (DATA)
EUROPEAN ACCESS LOOPS (1 kHz)
PACIFIC REMOTE ACCESS LOOPS (1 kHz)
PACIFIC REMOTE ACCESS LOOPS (DATA)
EUROPEAN REMOTE ACCESS LOOPS (1 kHz)
EUROPEAN REMOTE ACCESS LOOPS (DATA)
60
55
50
45
40
35
30
25
20
15
10
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-6

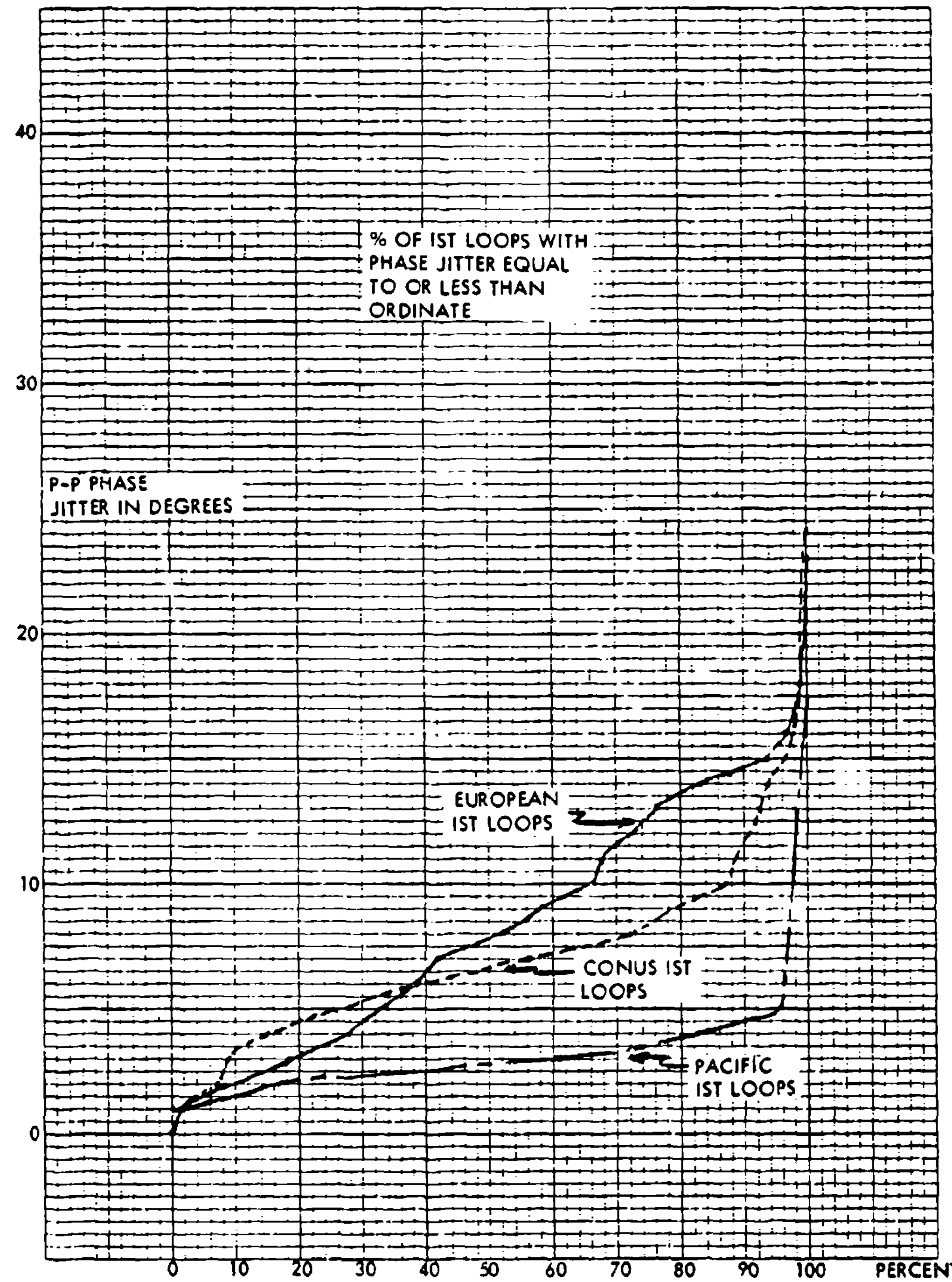
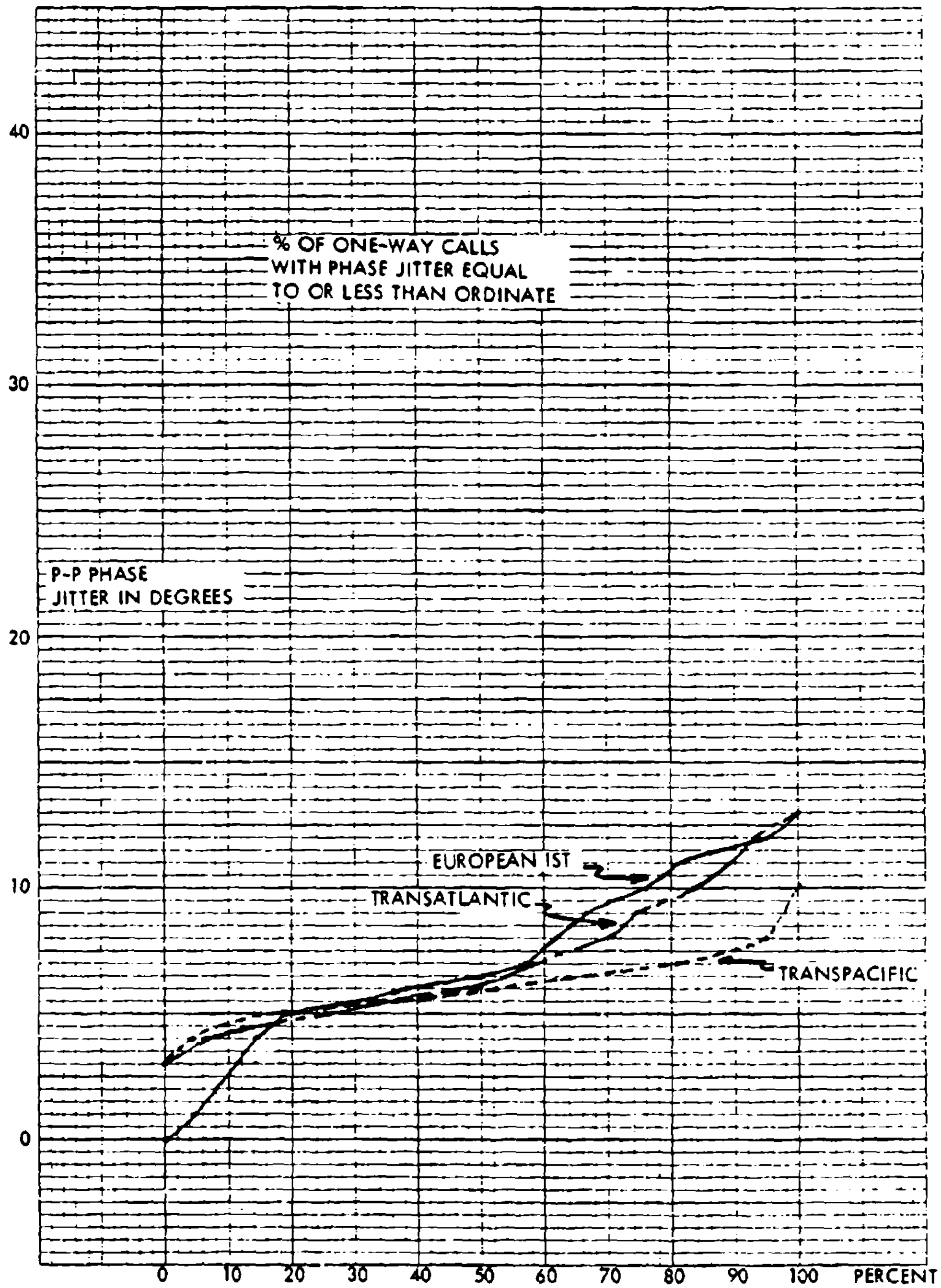
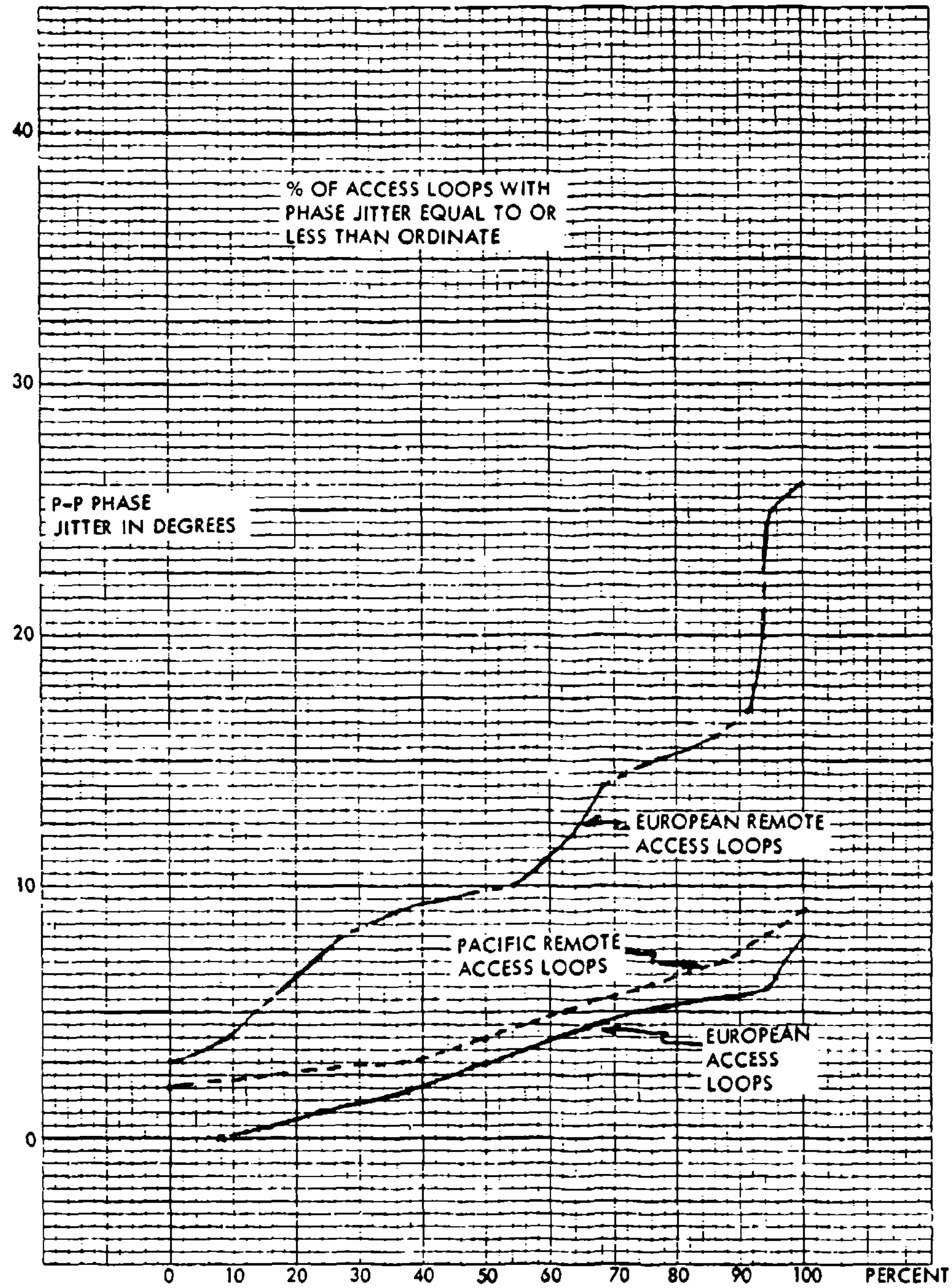

% OF IST LOOPS WITH PHASE JITTER EQUAL TO OR LESS THAN ORDINATE
P-P PHASE JITTER IN DEGREES
EUROPEAN IST LOOPS
CONUS IST LOOPS
PACIFIC IST LOOPS
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-7



% OF ONE-WAY CALLS
WITH PHASE JITTER EQUAL
TO OR LESS THAN ORDINATE
P-P PHASE
JITTER IN DEGREES
EUROPEAN IST
TRANSATLANTIC
TRANSPACIFIC
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-8



40
30
20
10
0
% OF ACCESS LOOPS WITH PHASE JITTER EQUAL TO OR LESS THAN ORDINATE
P-P PHASE JITTER IN DEGREES
EUROPEAN REMOTE ACCESS LOOPS
PACIFIC REMOTE ACCESS LOOPS
EUROPEAN ACCESS LOOPS
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-9

Table 2.3-2. Phase Jitter Spectrum

Call No.	Highest Spectral Peak		Overall Jitter Reading Degree P-P
	Approximate Frequency (Hz)	Approximate Magnitude Degree P-P	
18	50	3.8	6
20	100	1.9	4
21	130	3.8	25
22	50	11	15
23	20	7	15
24	50	7	23
27	130	2	8
30	100	2	11
31	100	2	10
37	100	2	7
38	100	4	10
39	100	4	10
46	20	3	12
47	50/100	5	14
51	50	1	14
52	50	1	12
53	20	3	16
55	—	1	13
58	50	1	13
60	20	2	9

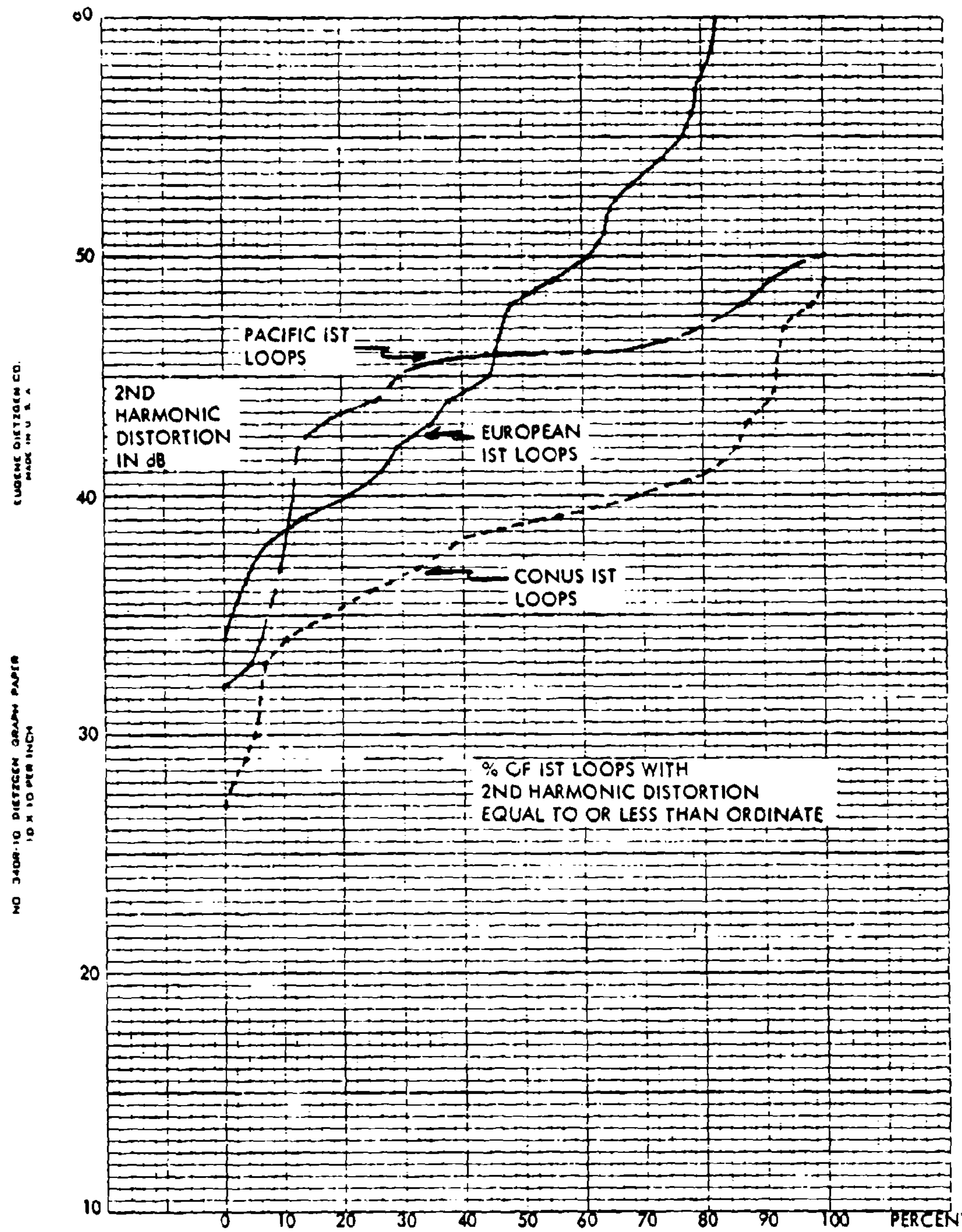
Table 2.3-2. Phase Jitter Spectrum (Continued)

Call No.	Highest Spectral Peak		Overall Jitter Reading Degree P-P
	Approximate Frequency (Hz)	Approximate Magnitude Degree P-P	
61	100	4	10
62	120	8	10
66	—	4	10
67	50	7	12
82	50	7	15
88	100	7	14
95	100	4	10
99	100	12	15
102	50	5	[illegible]
126	0	5	6
156	100	12	15
162	100	9	12
169	200	7	15
172	—	5	18
182	—	6	16
206	0	11	12
207	0	20	29
226	50	20	16-22
276	—	2	15
313	60	9	9

contained relatively small amounts of periodic jitter at line frequencies and their harmonics. Spectrally shaped white noise would represent a better jitter model than sinusoidal jitter at line frequency harmonics. Modeling the jitter with a line frequency square wave would place an unrealistic burden on the modem.

Figures 2.3-10 through 2.3-18 present harmonic distortion information. The curves concerning second and third harmonic distortion present the size of these harmonics in decibels below the size of the signal tones transmitted during the harmonic distortion measurement. A more detailed description of the technique employed in the harmonic distortion measurement is given in Paragraph 2.4. Figures 2.3-16, 2.3-17, and 2.3-18 present the total harmonic distortion as a percent of the transmitted signal. It is interesting to note that on the calls where both one-way and looped data was obtained, the harmonic distortion on looped calls averaged 2.19 times that achieved on on-way calls. On this basis 80 percent of the CONUS IST lines tested would have a total harmonic distortion of 1.54 percent or less. With the exception of the Pacific remote access calls all of the types of overseas calls had 80 percent values in the vicinity of 1.5 percent or less. It is suspected that bad harmonic distortion observed on the Pacific remote access loops was due to the nature of the loop-around rather than the actual circuits. However, this was not substantiated. As previously discussed the high harmonic distortion associated with the trans-Atlantic calls was felt to be primarily due to the CONUS access lines rather than the trans-Atlantic lines.

Figures 2.3-19 through 2.3-30 present data on various hit activity in the channel. Figures 2.3-19, 2.3-20 and 2.3-21 show the distribution of the number of 3 dB amplitude hits in a 5-minute period. Figures 2.3-22, 2.3-23, and 2.3-24 show the distribution of 20° phase hits per 5-minute period. Figures 2.3-25, 2.3-26, and 2.3-27 give impulse noise distribution over a 5-minute period. The threshold settings for the impulse noise measurements were set at 67, 63, and 59 DBRNO. Figures 2.3-28, 2.3-29 and 2.3-30 show the distribution of dropouts. Paragraph 2.4 will describe the technique of measuring these channel hit phenomena.



PACIFIC IST LOOPS
2ND HARMONIC DISTORTION IN dB
EUROPEAN IST LOOPS
CONUS IST LOOPS
% OF IST LOOPS WITH 2ND HARMONIC DISTORTION EQUAL TO OR LESS THAN ORDINATE
PERCENT

Figure 2.3-10

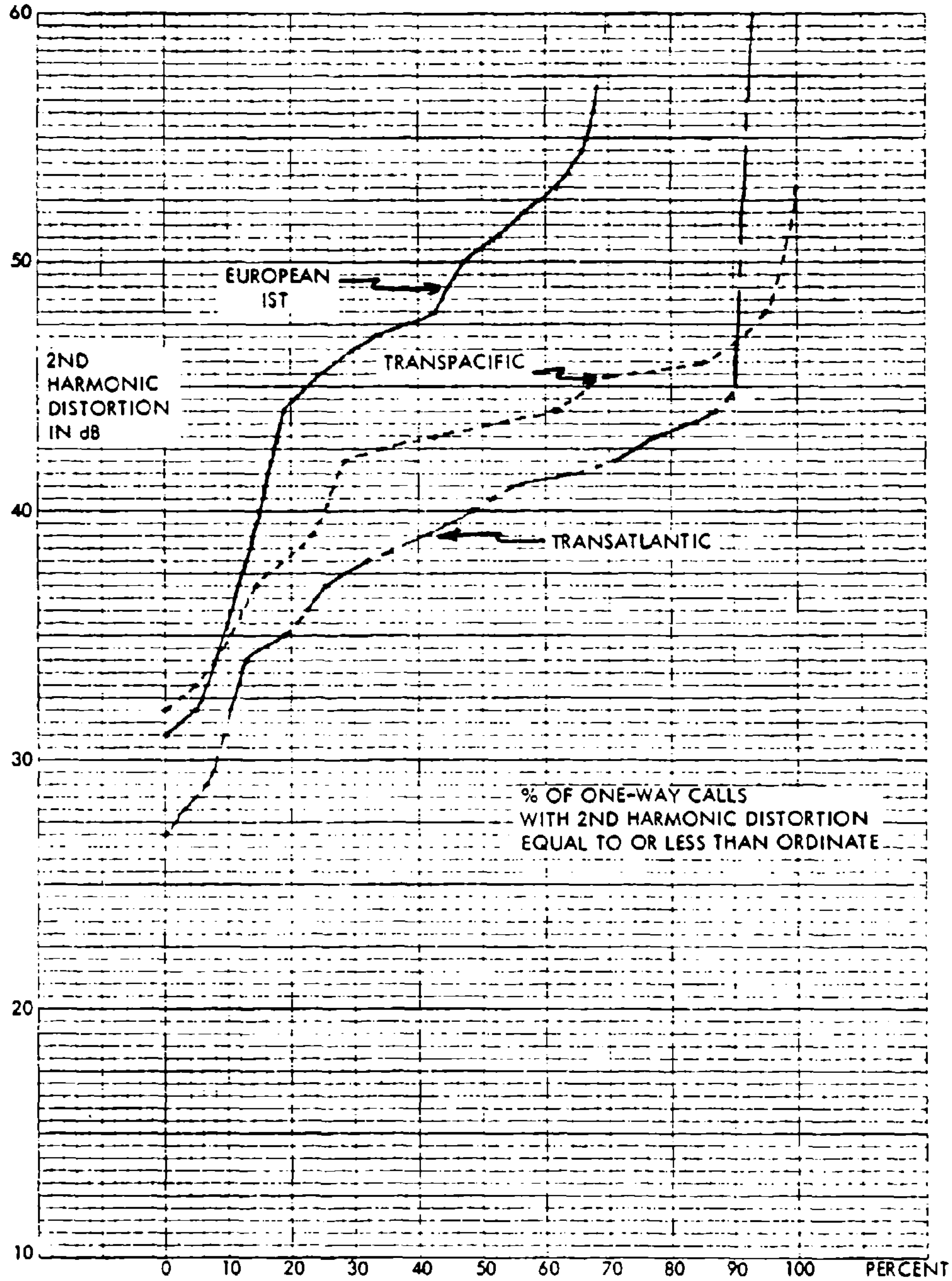

60
50
40
30
20
10
2ND
HARMONIC
DISTORTION
IN dB
EUROPEAN
IST
TRANSPACIFIC
TRANSATLANTIC
% OF ONE-WAY CALLS
WITH 2ND HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-11

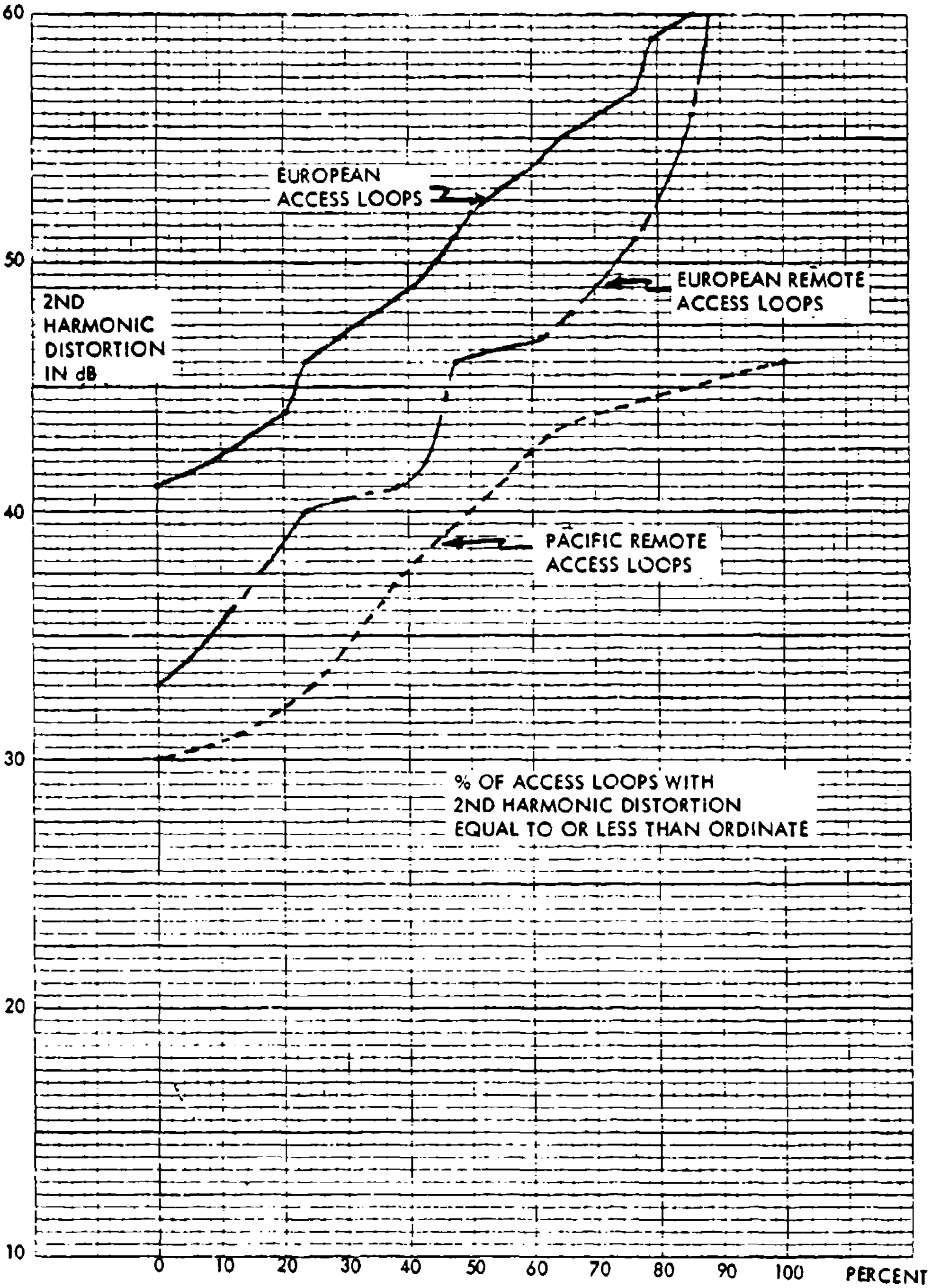

EUROPEAN
ACCESS LOOPS
EUROPEAN REMOTE
ACCESS LOOPS
2ND
HARMONIC
DISTORTION
IN dB
PACIFIC REMOTE
ACCESS LOOPS
% OF ACCESS LOOPS WITH
2ND HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-12

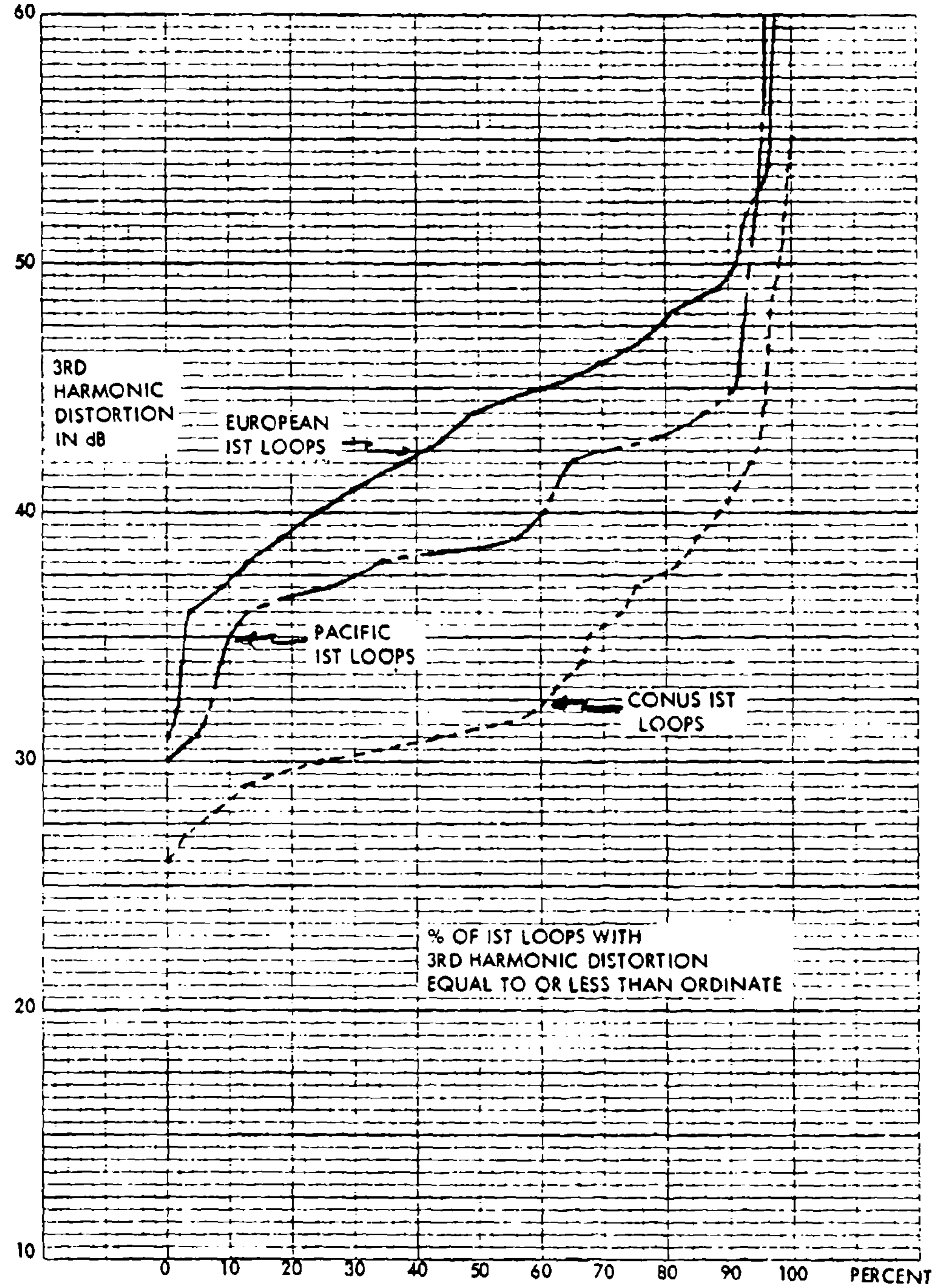

60
50
40
30
20
10
3RD
HARMONIC
DISTORTION
IN dB
EUROPEAN
1ST LOOPS
PACIFIC
1ST LOOPS
CONUS 1ST
LOOPS
% OF 1ST LOOPS WITH
3RD HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-13

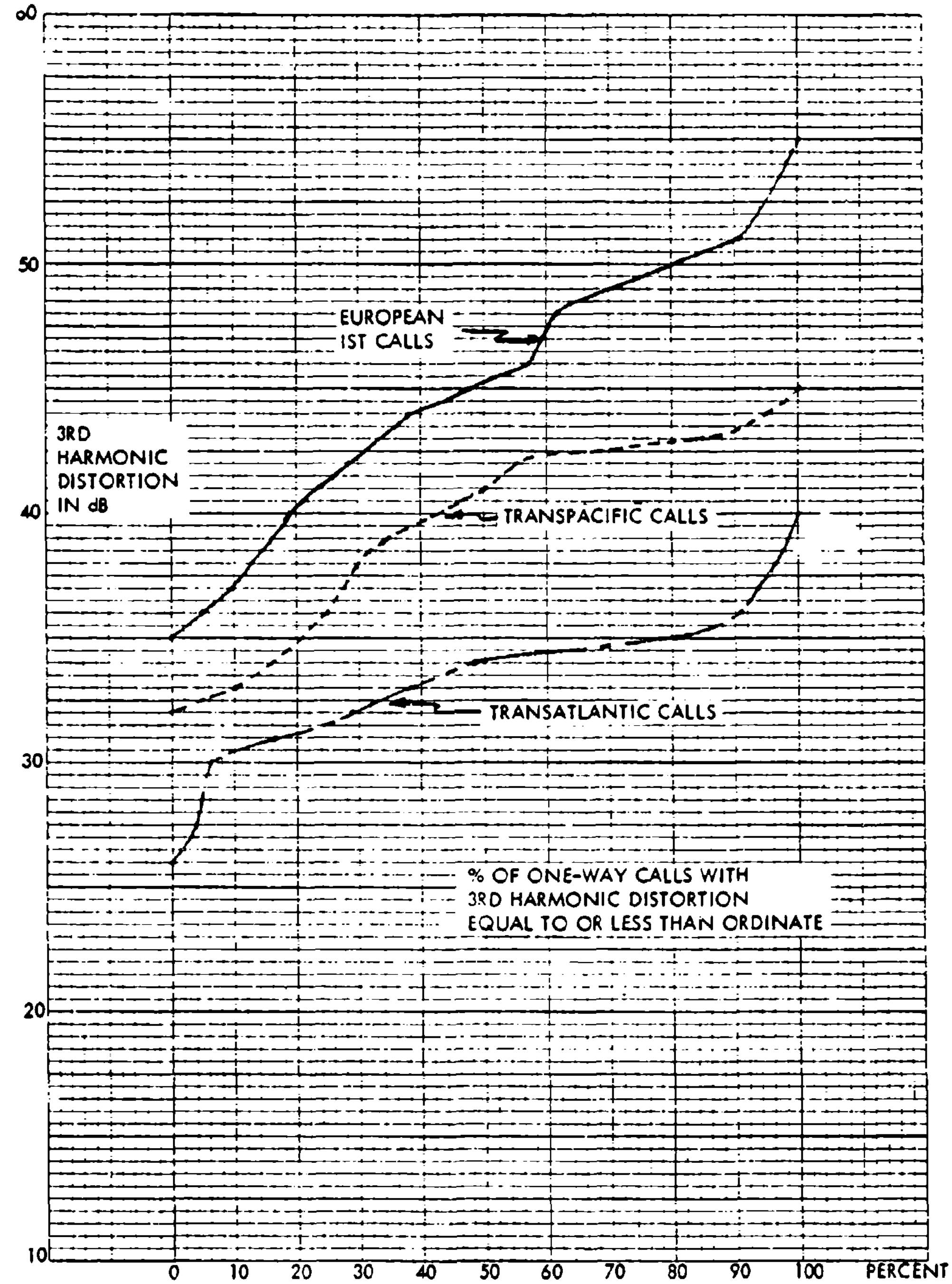

3RD
HARMONIC
DISTORTION
IN dB
EUROPEAN
1ST CALLS
TRANSPACIFIC CALLS
TRANSATLANTIC CALLS
% OF ONE-WAY CALLS WITH
3RD HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
PERCENT
0
10
20
30
40
50
60
70
80
90
100
60
50
40
30
20
10

Figure 2.3-14

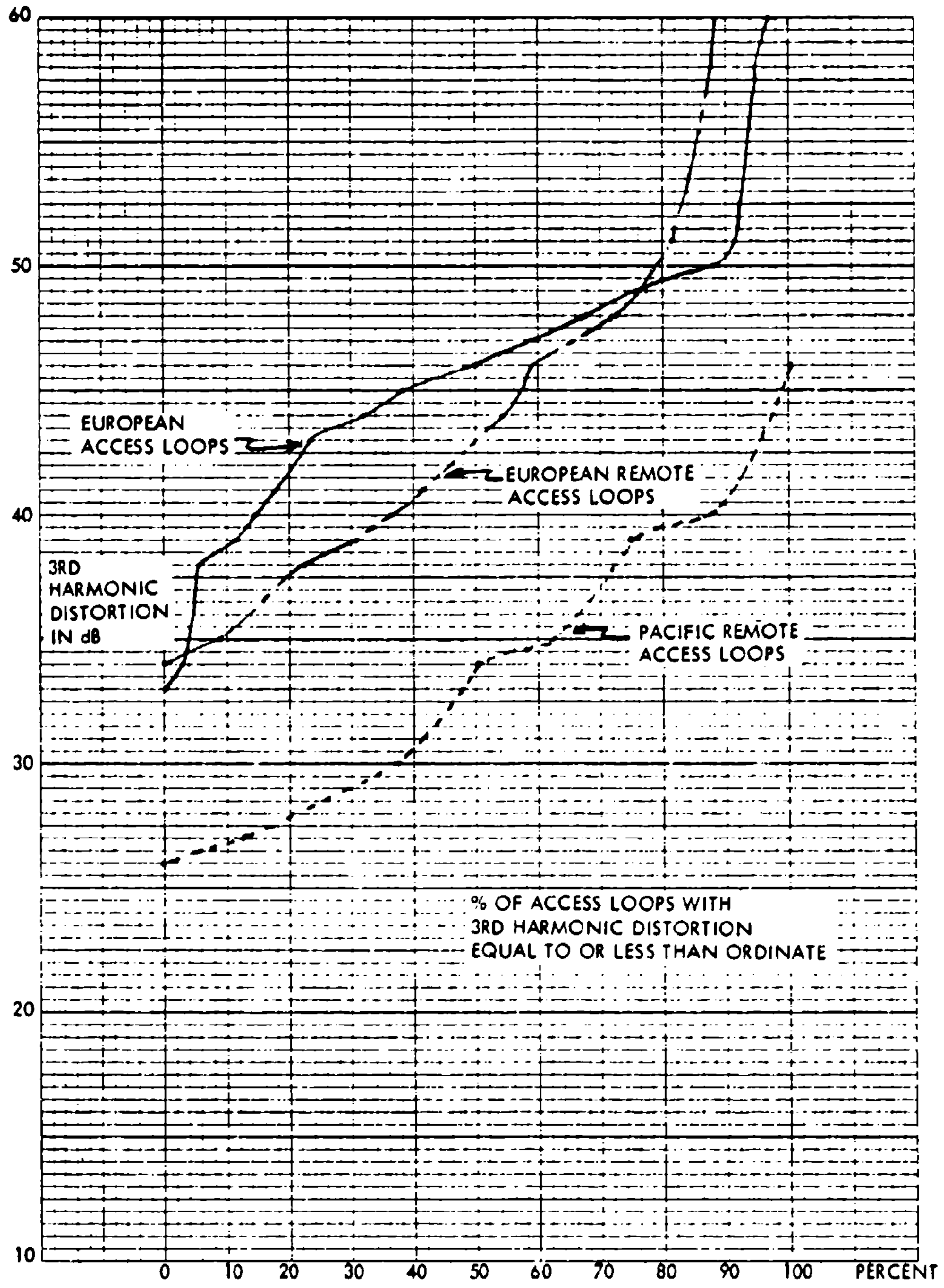

60
50
40
30
20
10
EUROPEAN
ACCESS LOOPS
EUROPEAN REMOTE
ACCESS LOOPS
3RD
HARMONIC
DISTORTION
IN dB
PACIFIC REMOTE
ACCESS LOOPS
% OF ACCESS LOOPS WITH
3RD HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-15

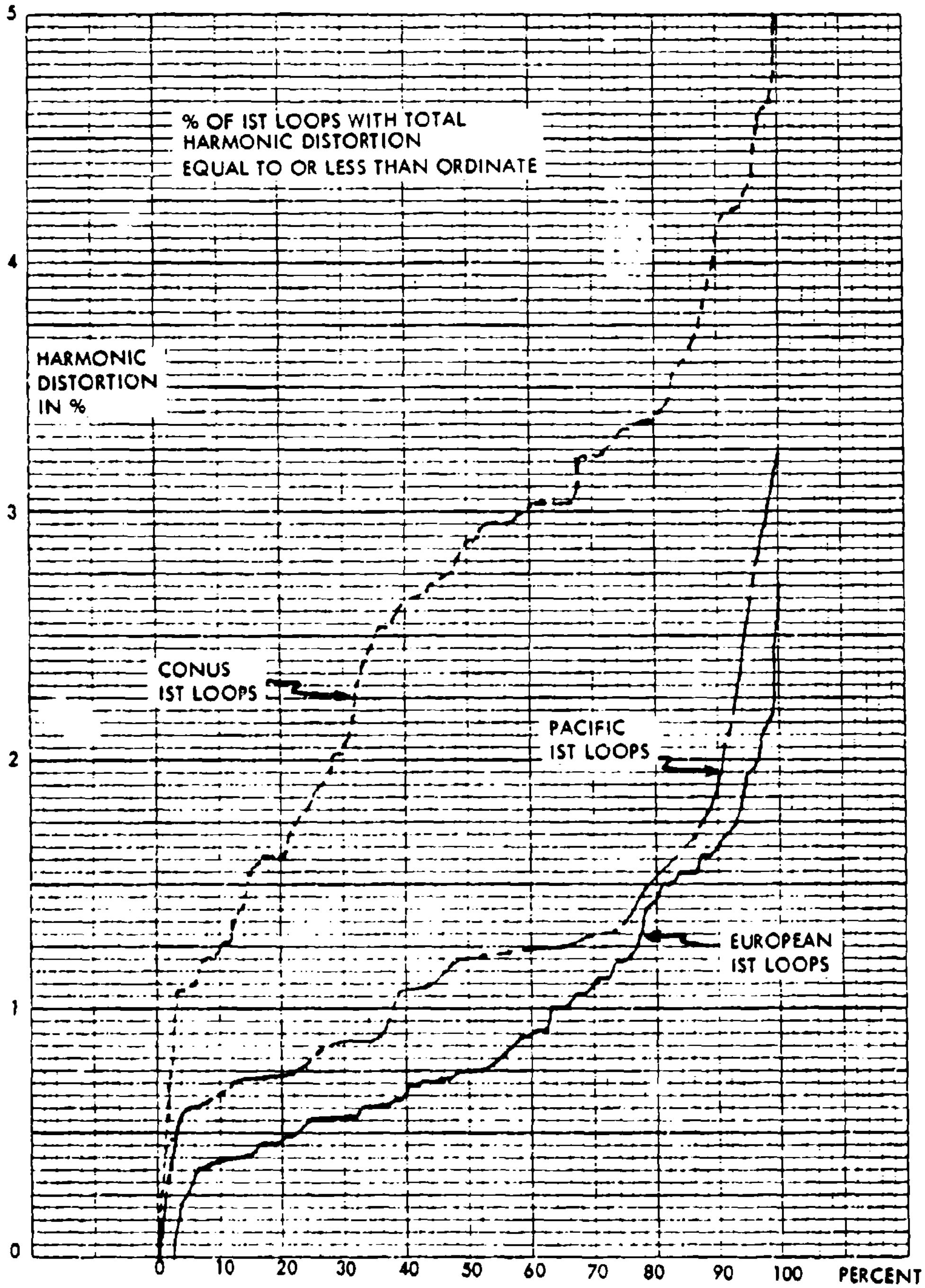
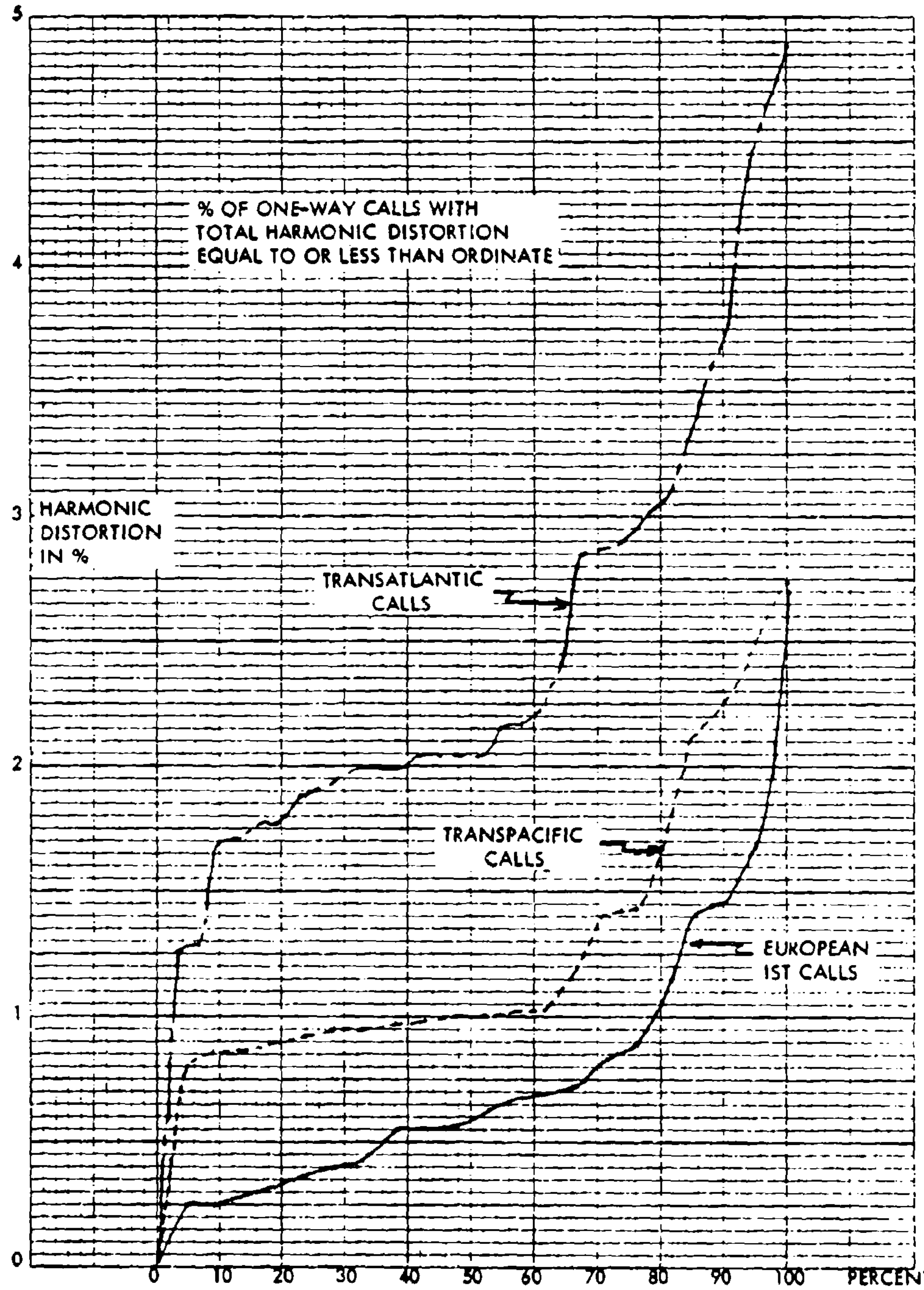
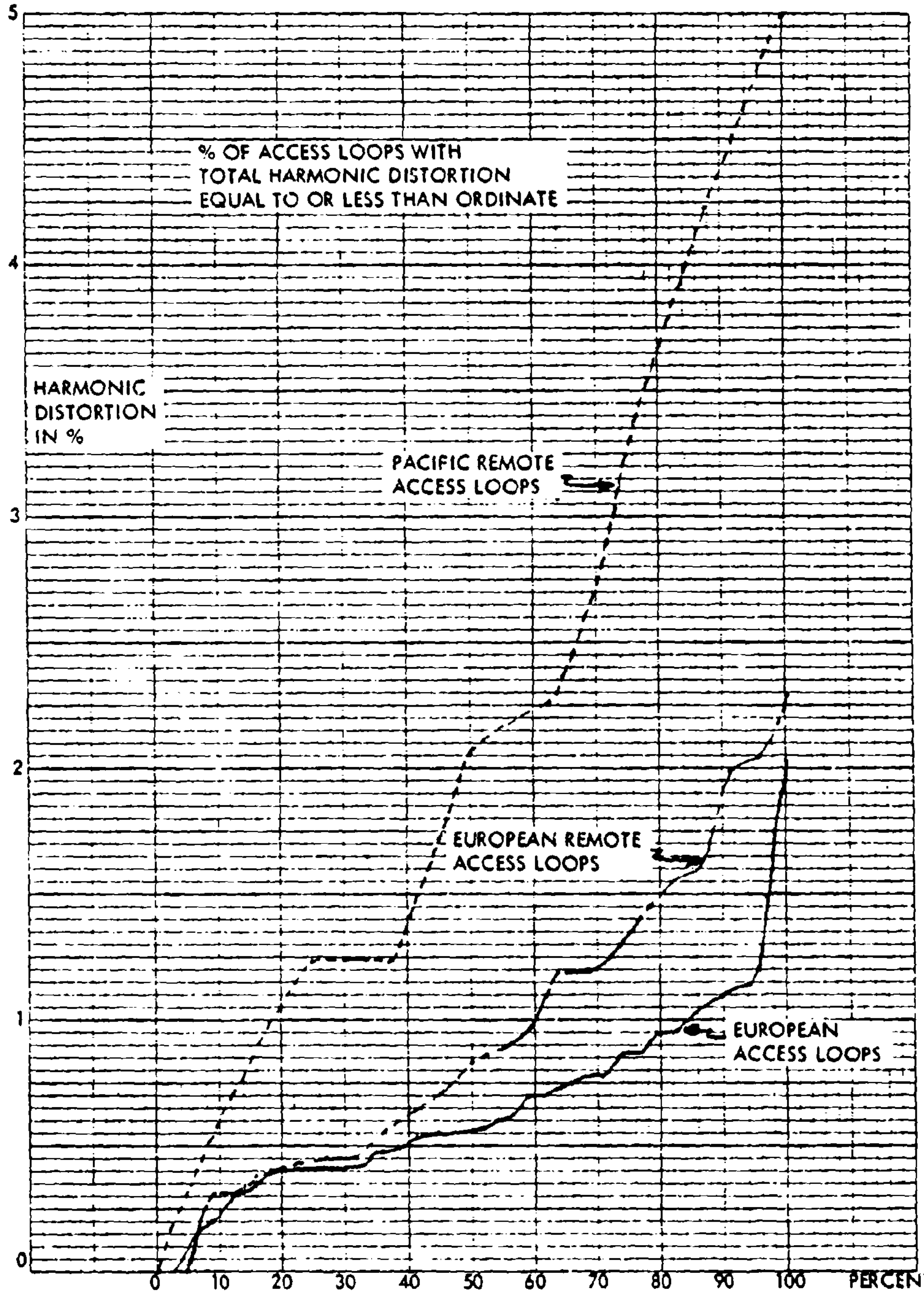

% OF IST LOOPS WITH TOTAL HARMONIC DISTORTION EQUAL TO OR LESS THAN ORDINATE
HARMONIC DISTORTION IN %
CONUS IST LOOPS
PACIFIC IST LOOPS
EUROPEAN IST LOOPS
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-16



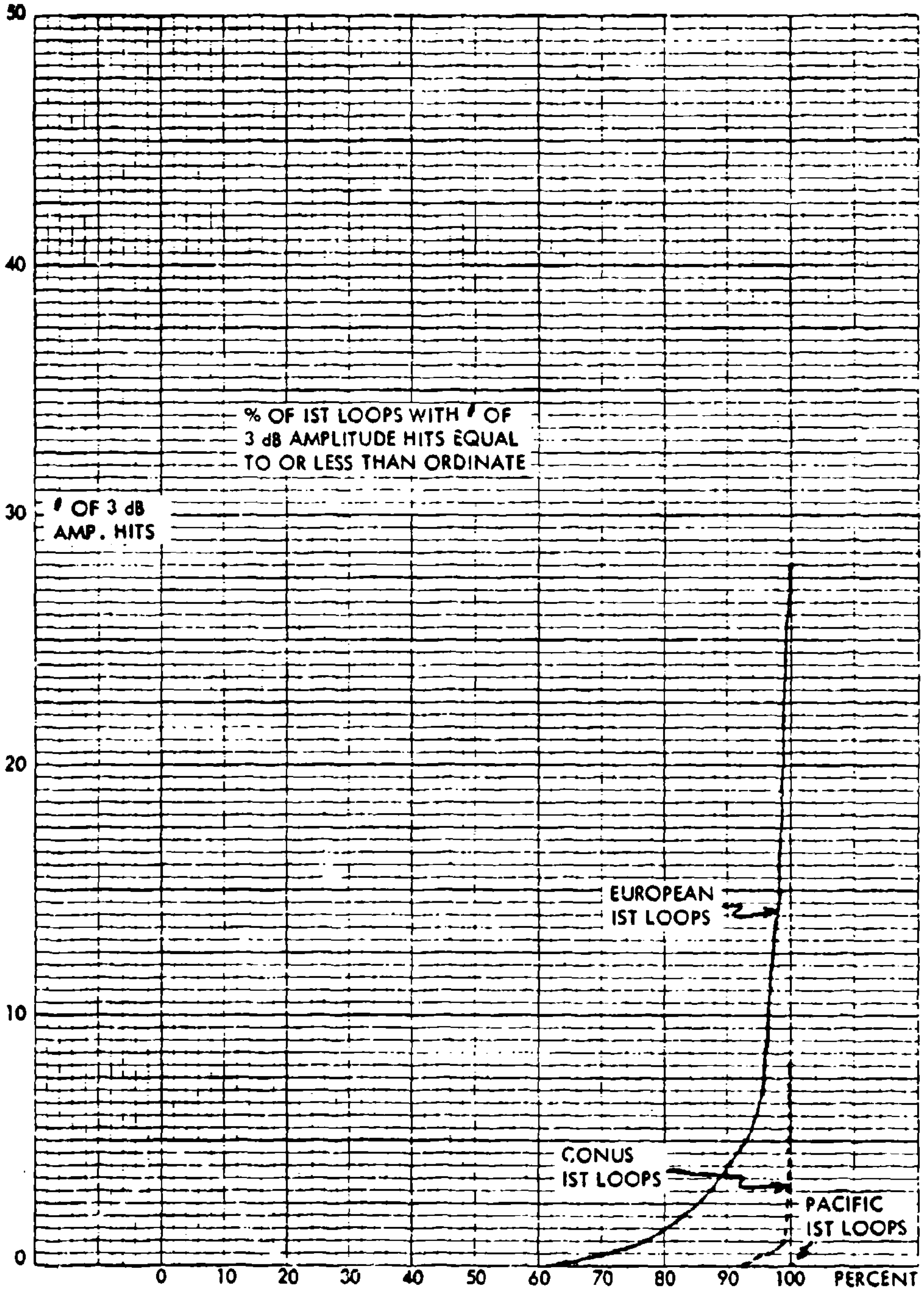
% OF ONE-WAY CALLS WITH
TOTAL HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
HARMONIC
DISTORTION
IN %
TRANSATLANTIC
CALLS
TRANSPACIFIC
CALLS
EUROPEAN
IST CALLS
0
1
2
3
4
5
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-17



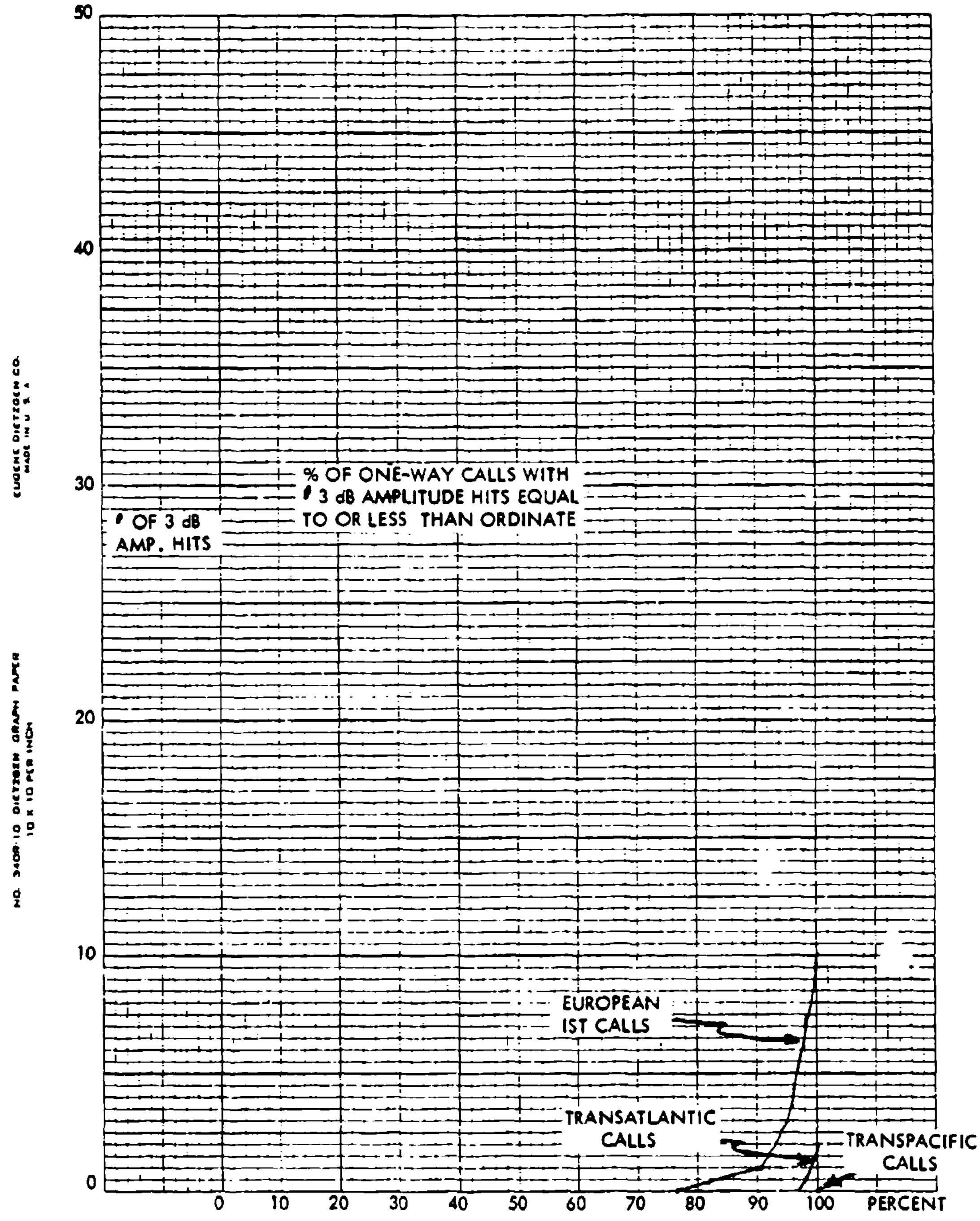
5
4
3
2
1
0
% OF ACCESS LOOPS WITH
TOTAL HARMONIC DISTORTION
EQUAL TO OR LESS THAN ORDINATE
HARMONIC
DISTORTION
IN %
PACIFIC REMOTE
ACCESS LOOPS
EUROPEAN REMOTE
ACCESS LOOPS
EUROPEAN
ACCESS LOOPS
0 10 20 30 40 50 60 70 80 90 100 PERCENT

Figure 2.3-18



% OF IST LOOPS WITH # OF
3 dB AMPLITUDE HITS EQUAL
TO OR LESS THAN ORDINATE
OF 3 dB
AMP. HITS
EUROPEAN
IST LOOPS
CONUS
IST LOOPS
PACIFIC
IST LOOPS
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 PERCENT

Figure 2.3-19



% OF ONE-WAY CALLS WITH
# 3 dB AMPLITUDE HITS EQUAL
TO OR LESS THAN ORDINATE
OF 3 dB
AMP. HITS
EUROPEAN
IST CALLS
TRANSATLANTIC
CALLS
TRANSPACIFIC
CALLS
0
10
20
30
40
50
0
10
20
30
40
50
60
70
80
90
100
PERCENT
NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
EUGENE DIETZGEN CO.
MADE IN U.S.A.

Figure 2.3-20

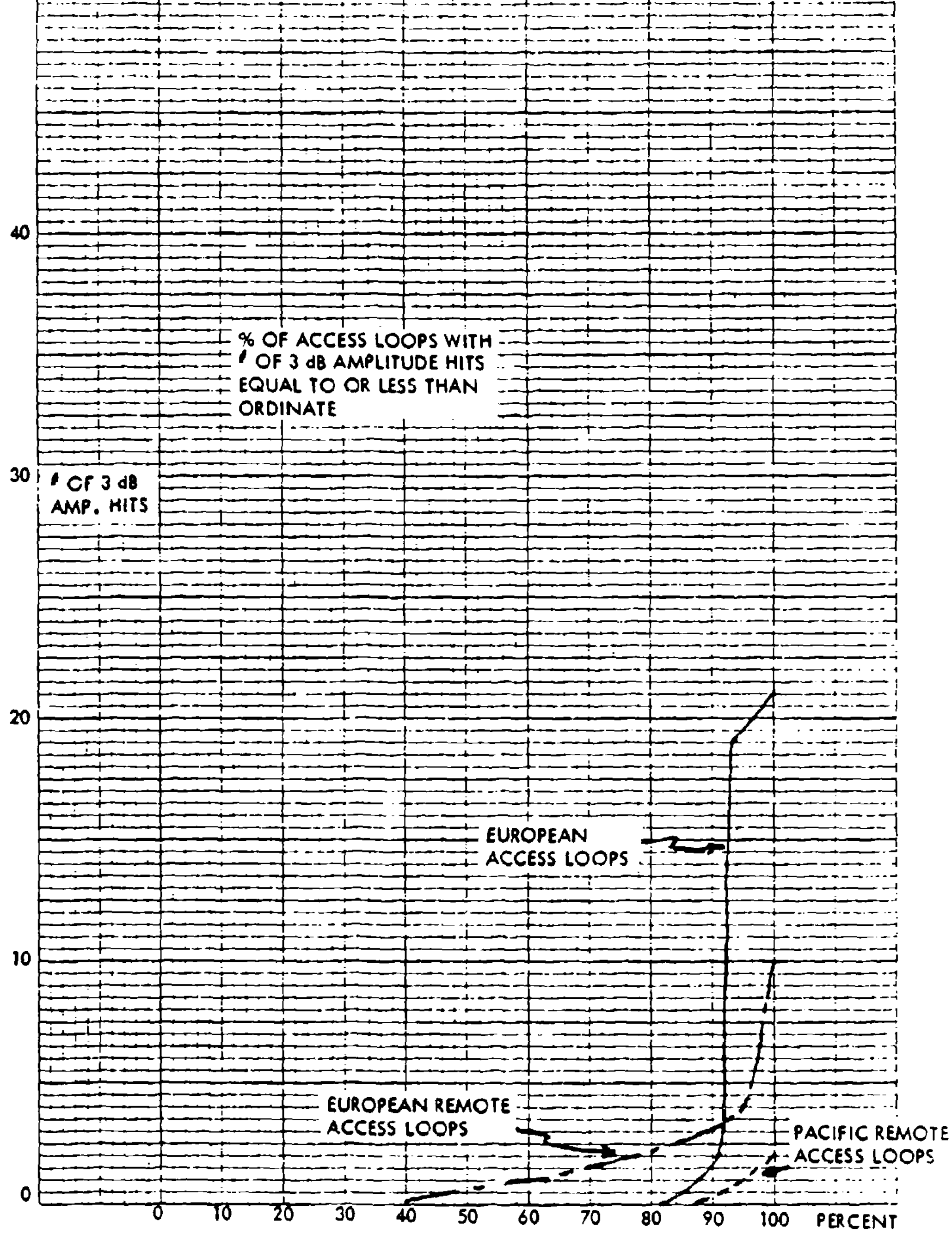
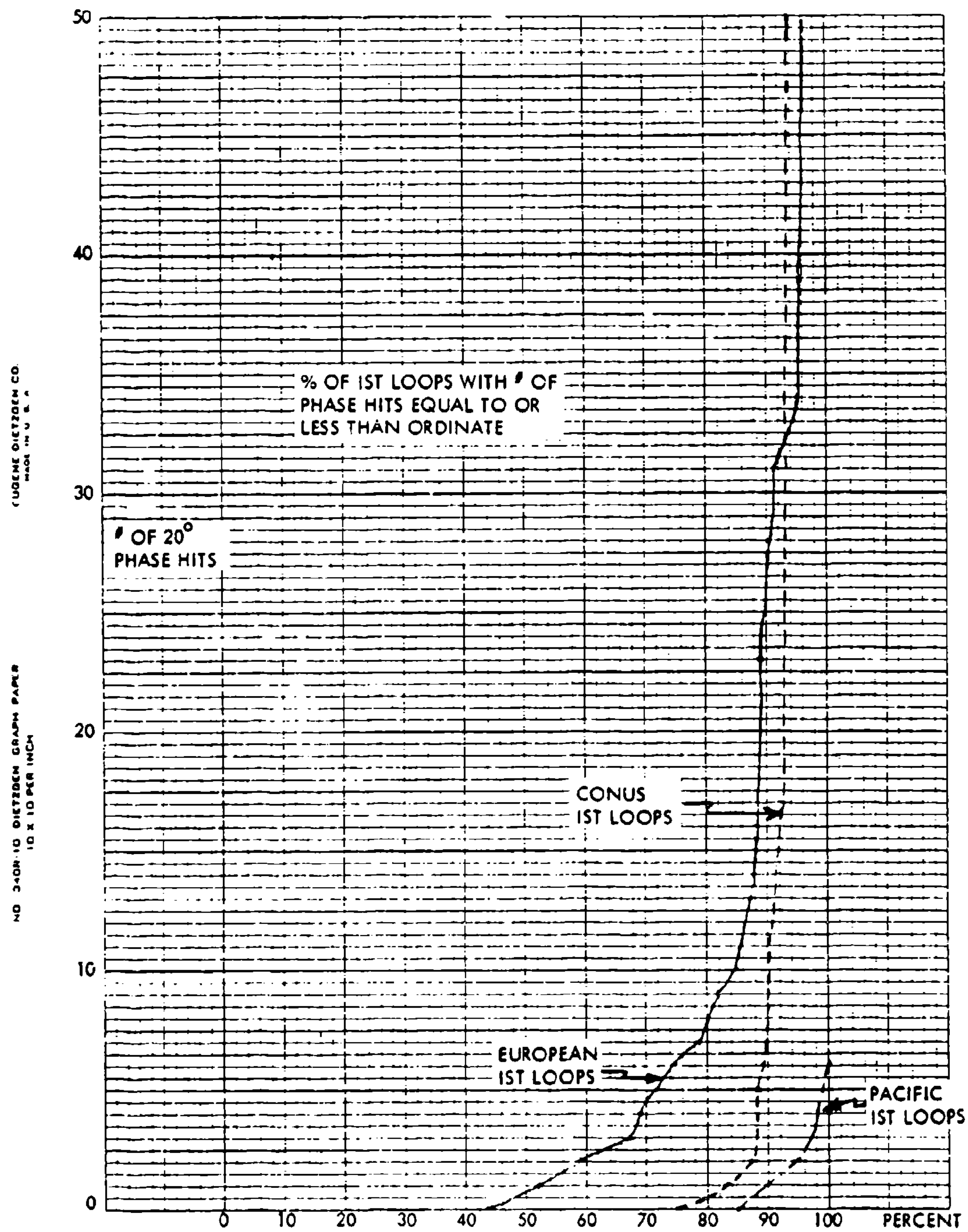
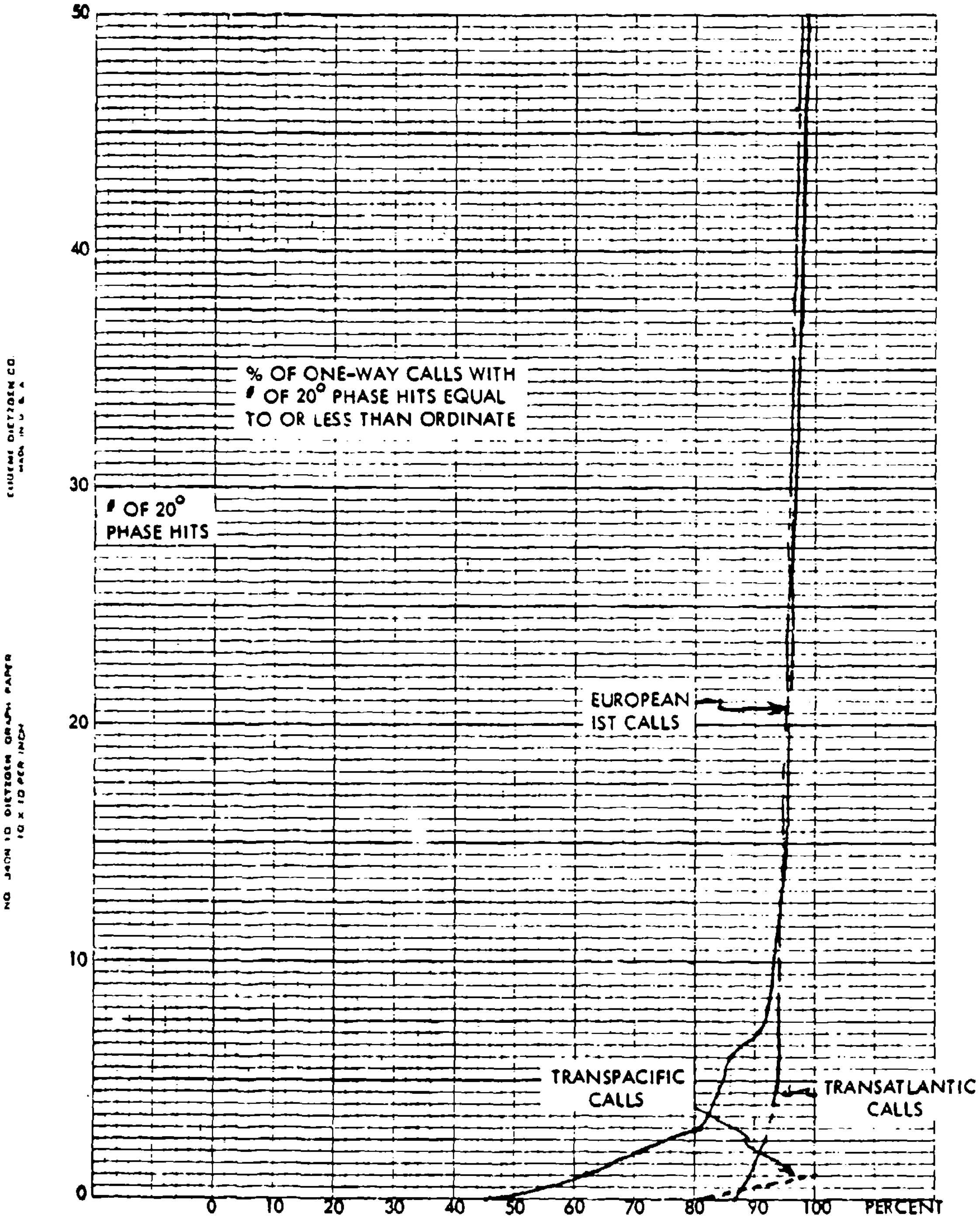

% OF ACCESS LOOPS WITH
# OF 3 dB AMPLITUDE HITS
EQUAL TO OR LESS THAN
ORDINATE
OF 3 dB
AMP. HITS
EUROPEAN
ACCESS LOOPS
EUROPEAN REMOTE
ACCESS LOOPS
PACIFIC REMOTE
ACCESS LOOPS
PERCENT
0
10
20
30
40
50
60
70
80
90
100

Figure 2.3-21



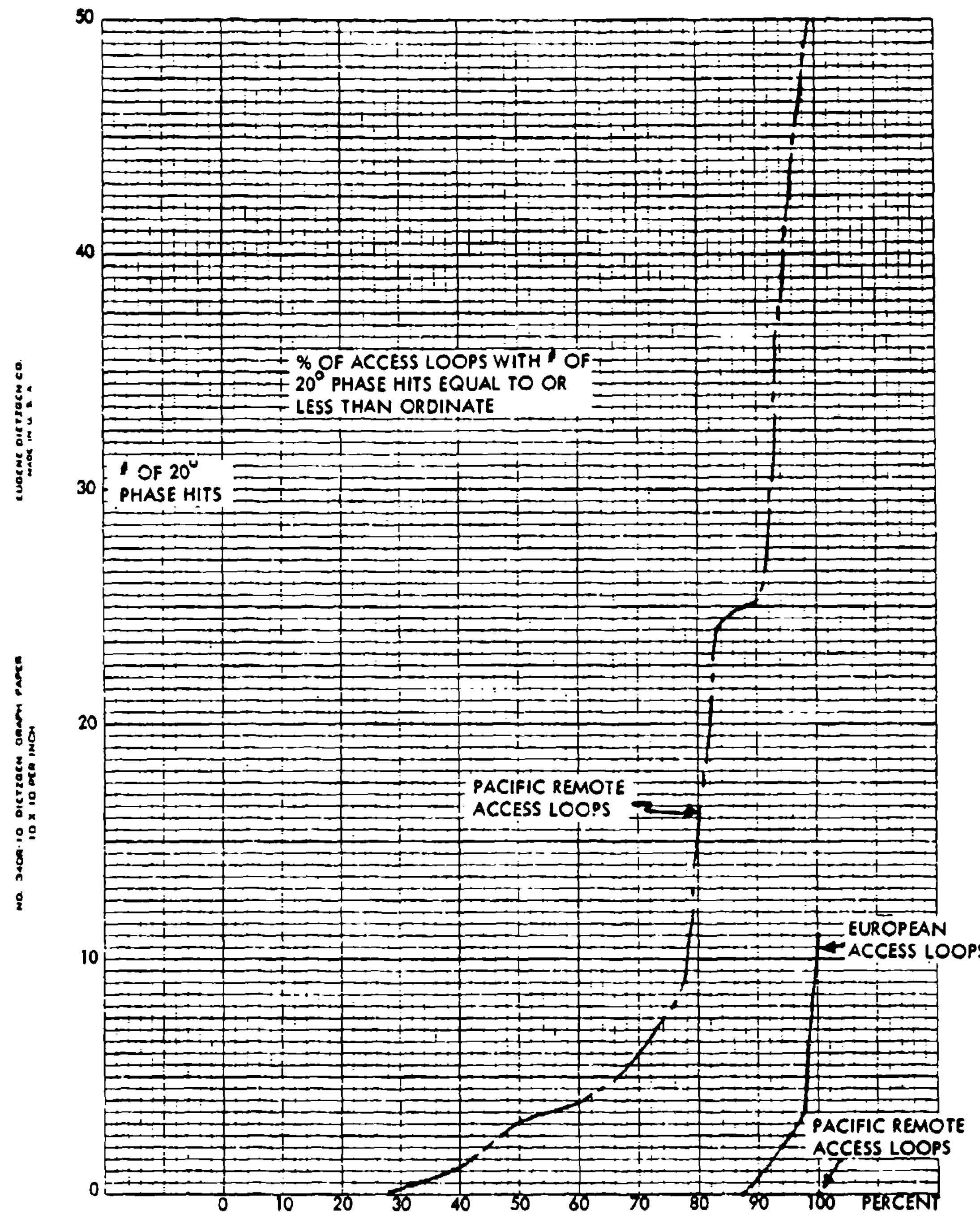
% OF 1ST LOOPS WITH # OF
PHASE HITS EQUAL TO OR
LESS THAN ORDINATE
OF 20°
PHASE HITS
CONUS
1ST LOOPS
EUROPEAN
1ST LOOPS
PACIFIC
1ST LOOPS
PERCENT

Figure 2.3-22



50
40
30
20
10
0
% OF ONE-WAY CALLS WITH # OF 20° PHASE HITS EQUAL TO OR LESS THAN ORDINATE
# OF 20° PHASE HITS
EUROPEAN IST CALLS
TRANSPACIFIC CALLS
TRANSATLANTIC CALLS
0
10
20
30
40
50
60
70
80
90
100
PERCENT
NO. 340N 10 DIETZGEN GRAPH PAPER 10 X 10 PER INCH
EUGENE DIETZGEN CO. MADE IN U.S.A.

Figure 2.3-23



% OF ACCESS LOOPS WITH # OF 20° PHASE HITS EQUAL TO OR LESS THAN ORDINATE
# OF 20° PHASE HITS
PACIFIC REMOTE ACCESS LOOPS
EUROPEAN ACCESS LOOPS
PACIFIC REMOTE ACCESS LOOPS
PERCENT
0
10
20
30
40
50
60
70
80
90
100

Figure 2.3-24

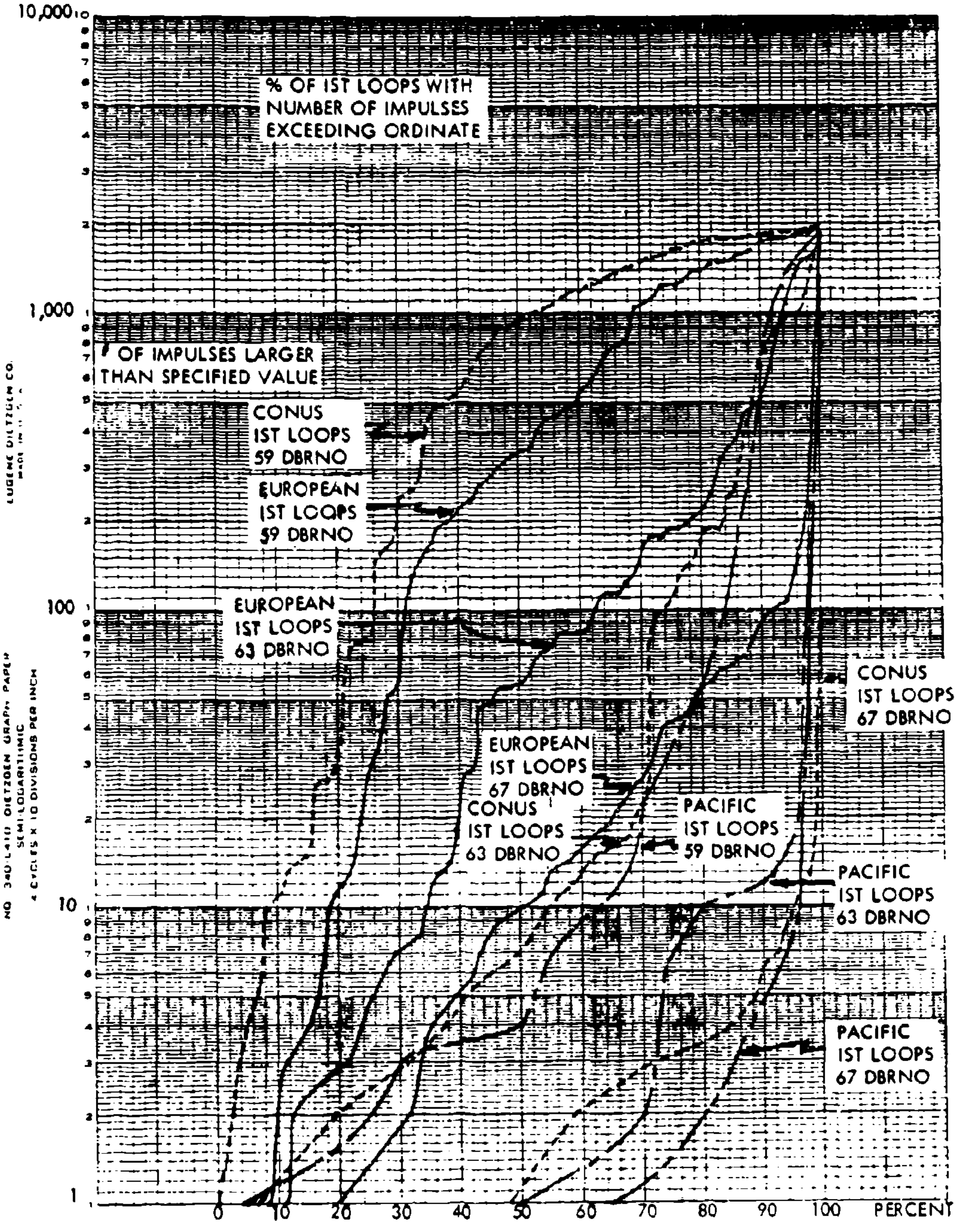
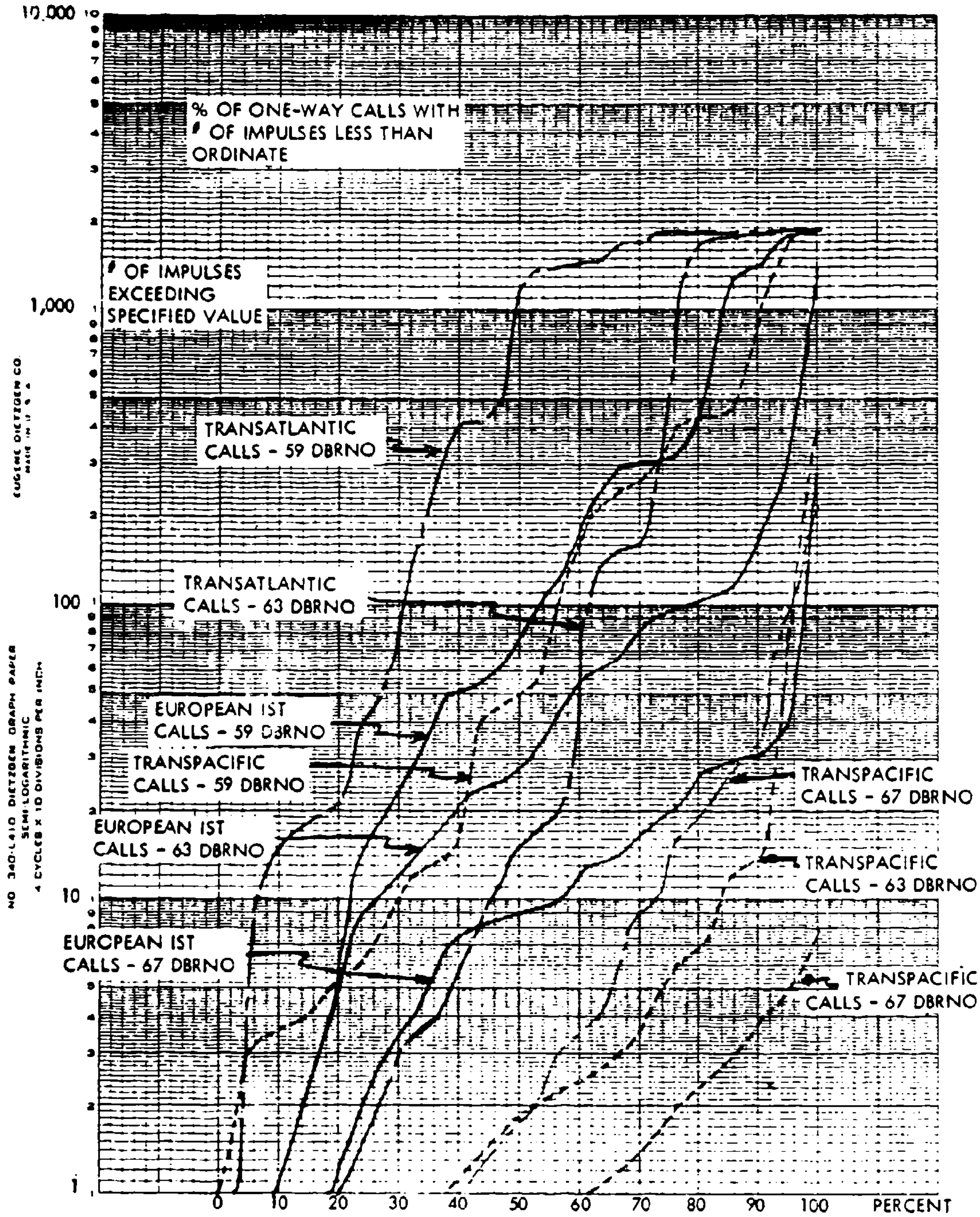

% OF 1ST LOOPS WITH
NUMBER OF IMPULSES
EXCEEDING ORDINATE
OF IMPULSES LARGER
THAN SPECIFIED VALUE
CONUS
1ST LOOPS
59 DBRNO
EUROPEAN
1ST LOOPS
59 DBRNO
EUROPEAN
1ST LOOPS
63 DBRNO
CONUS
1ST LOOPS
67 DBRNO
EUROPEAN
1ST LOOPS
67 DBRNO
CONUS
1ST LOOPS
63 DBRNO
PACIFIC
1ST LOOPS
59 DBRNO
PACIFIC
1ST LOOPS
63 DBRNO
PACIFIC
1ST LOOPS
67 DBRNO
10,000
1,000
100
10
1
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-25



% OF ONE-WAY CALLS WITH # OF IMPULSES LESS THAN ORDINATE
# OF IMPULSES EXCEEDING SPECIFIED VALUE
TRANSATLANTIC CALLS - 59 DBRNO
TRANSATLANTIC CALLS - 63 DBRNO
EUROPEAN IST CALLS - 59 DBRNO
TRANSPACIFIC CALLS - 59 DBRNO
EUROPEAN IST CALLS - 63 DBRNO
EUROPEAN IST CALLS - 67 DBRNO
TRANSPACIFIC CALLS - 67 DBRNO
TRANSPACIFIC CALLS - 63 DBRNO
TRANSPACIFIC CALLS - 67 DBRNO
10,000
1,000
100
10
1
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-26

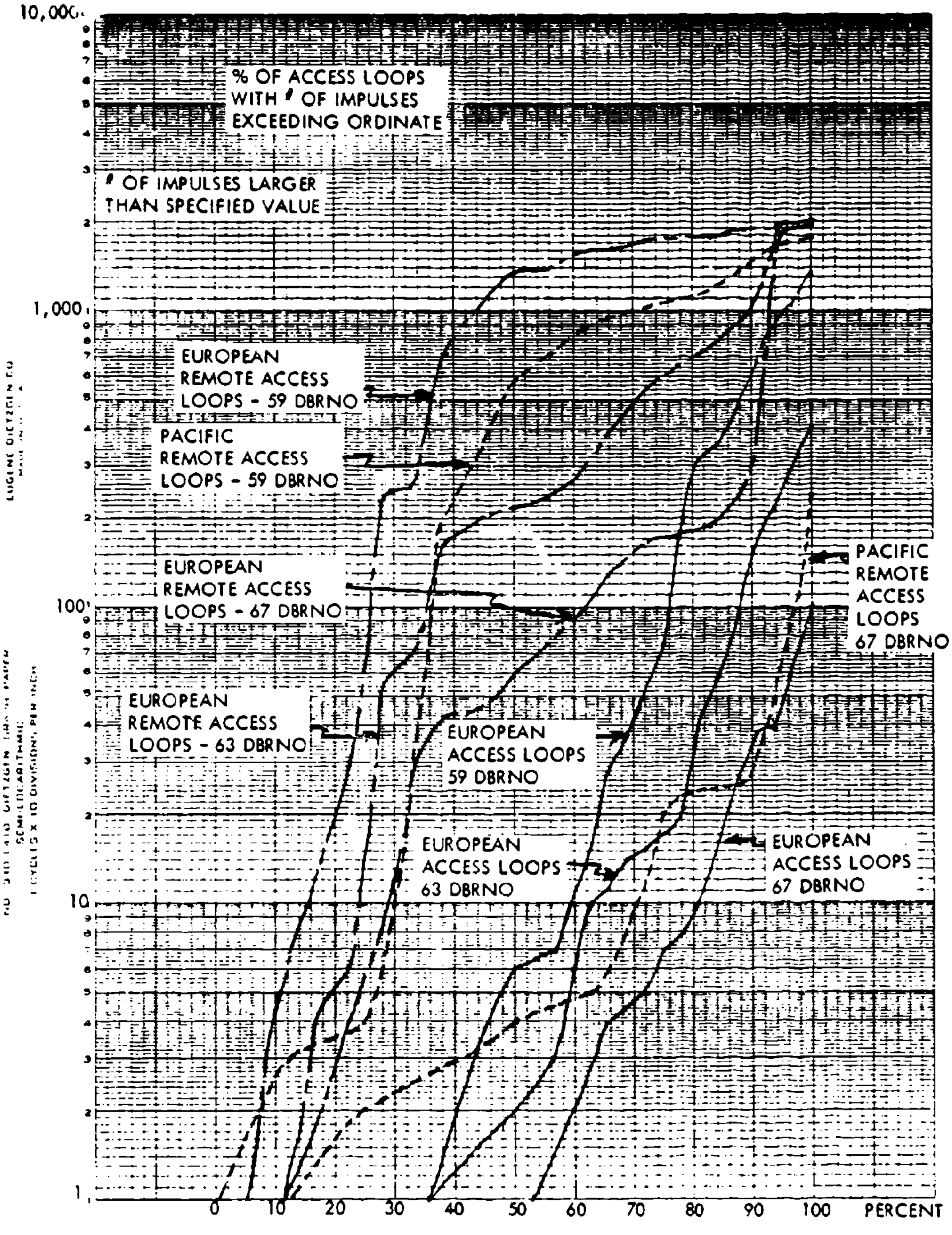
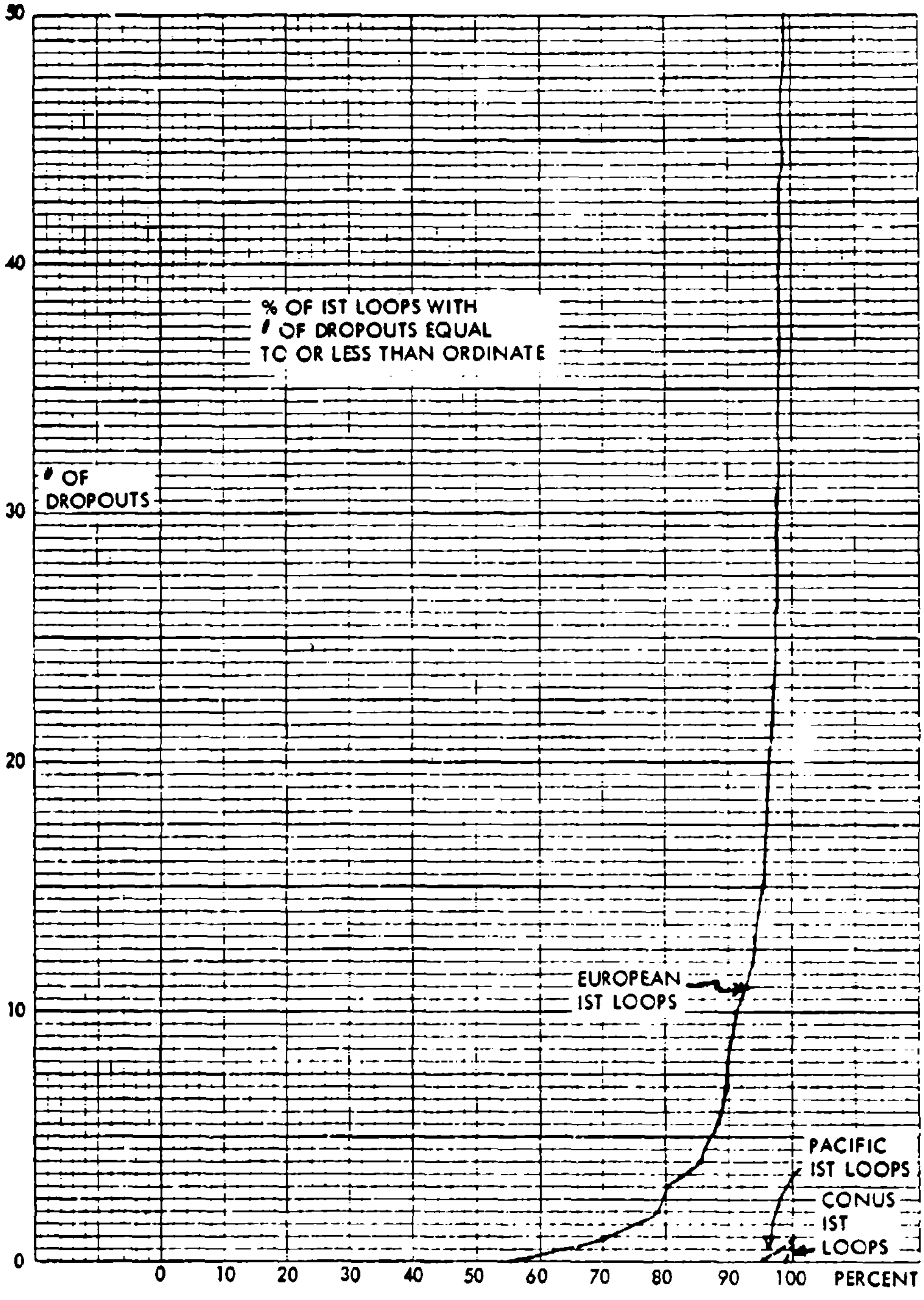

% OF ACCESS LOOPS WITH # OF IMPULSES EXCEEDING ORDINATE
# OF IMPULSES LARGER THAN SPECIFIED VALUE
EUROPEAN REMOTE ACCESS LOOPS - 59 DBRNO
PACIFIC REMOTE ACCESS LOOPS - 59 DBRNO
EUROPEAN REMOTE ACCESS LOOPS - 67 DBRNO
EUROPEAN REMOTE ACCESS LOOPS - 63 DBRNO
EUROPEAN ACCESS LOOPS 59 DBRNO
EUROPEAN ACCESS LOOPS 63 DBRNO
EUROPEAN ACCESS LOOPS 67 DBRNO
PACIFIC REMOTE ACCESS LOOPS 67 DBRNO
10,000
1,000
100
10
1
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.3-27



% OF IST LOOPS WITH
# OF DROPOUTS EQUAL
TO OR LESS THAN ORDINATE
OF
DROPOUTS
EUROPEAN
IST LOOPS
PACIFIC
IST LOOPS
CONUS
IST
LOOPS
PERCENT
0
10
20
30
40
50
60
70
80
90
100

Figure 2.3-28

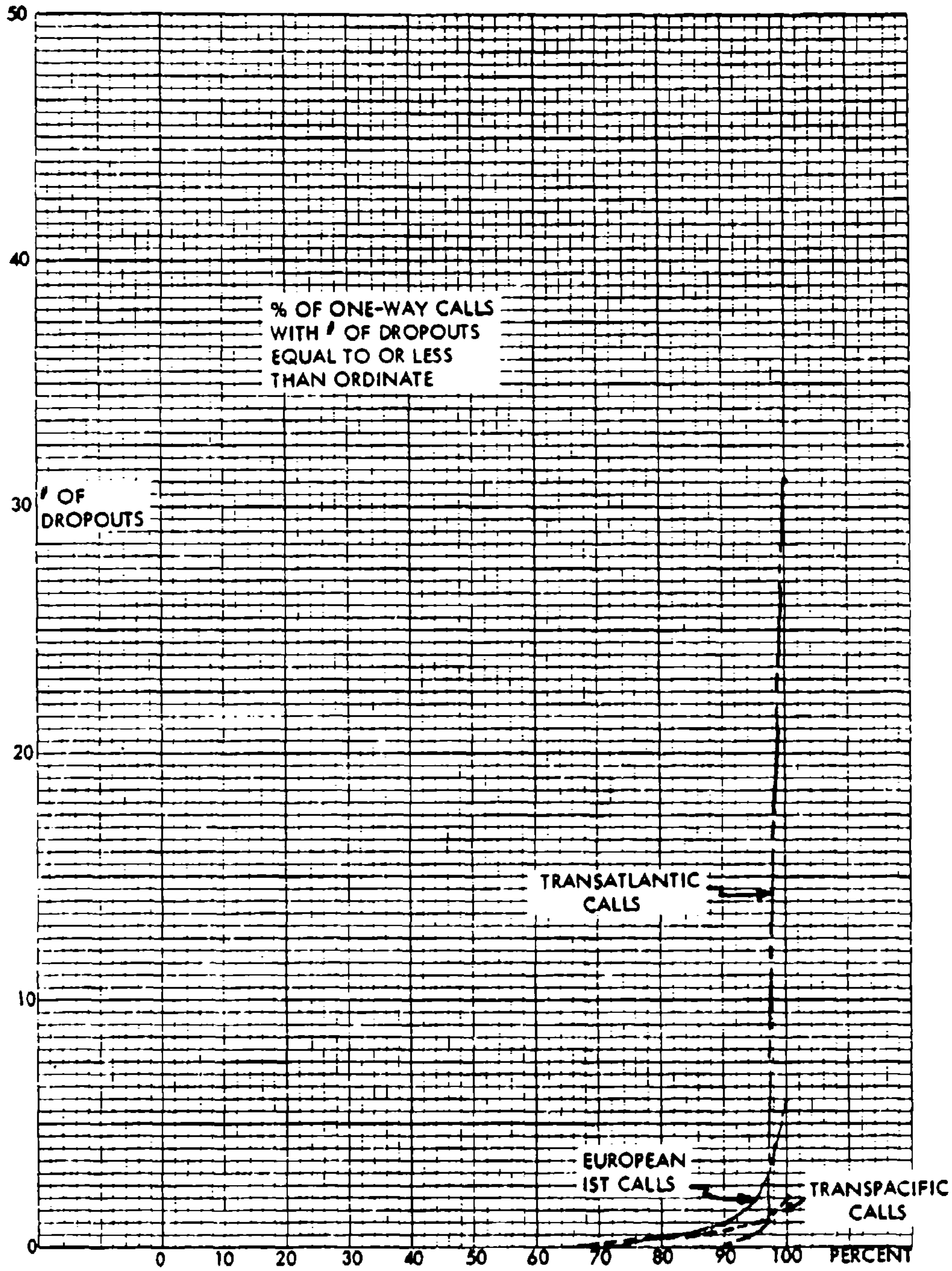

% OF ONE-WAY CALLS WITH # OF DROPOUTS EQUAL TO OR LESS THAN ORDINATE
# OF DROPOUTS
TRANSATLANTIC CALLS
EUROPEAN IST CALLS
TRANSPACIFIC CALLS
PERCENT
0
10
20
30
40
50
60
70
80
90
100

Figure 2.3-29

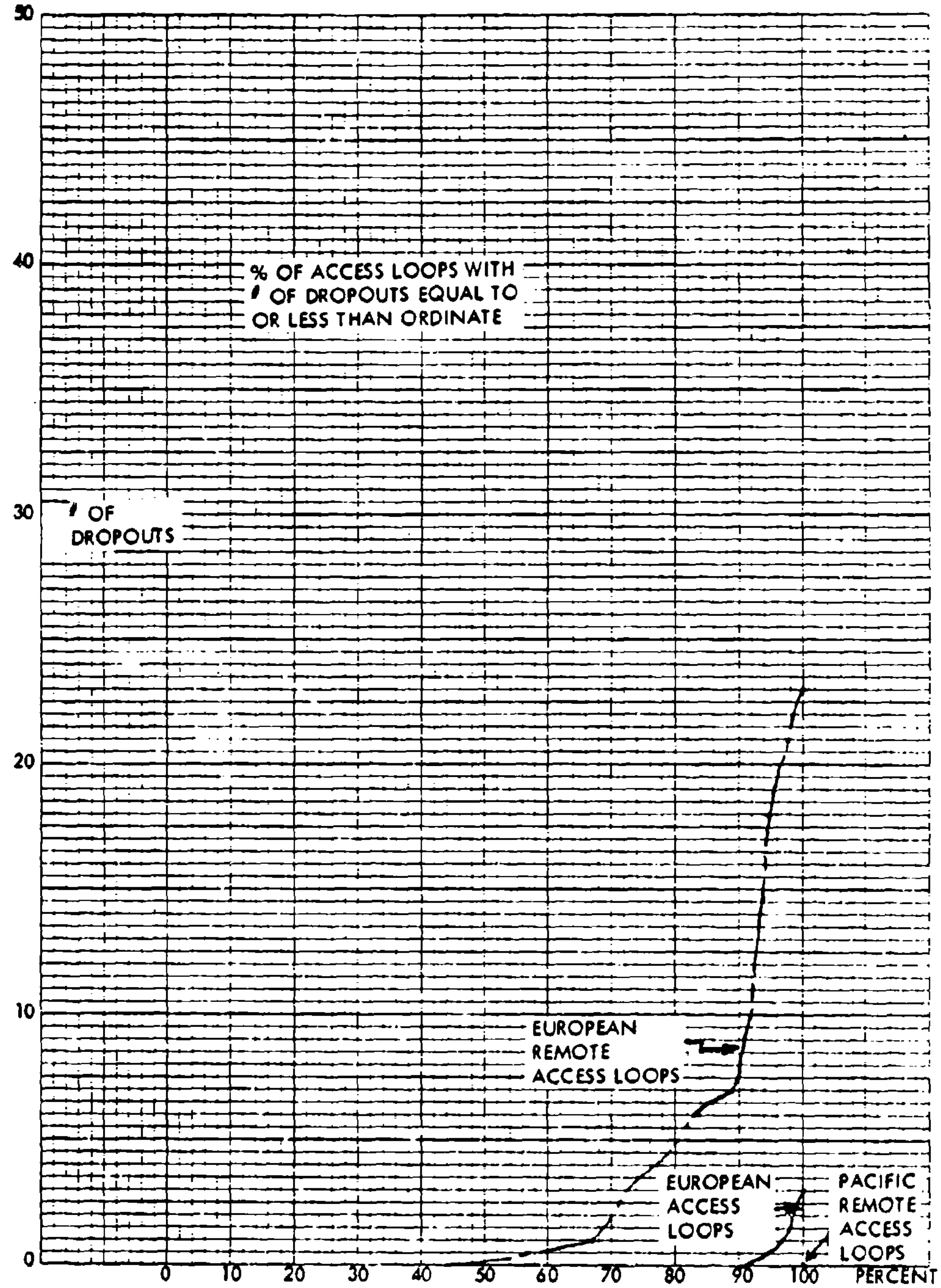

% OF ACCESS LOOPS WITH
# OF DROPOUTS EQUAL TO
OR LESS THAN ORDINATE
OF
DROPOUTS
EUROPEAN
REMOTE
ACCESS LOOPS
EUROPEAN
ACCESS
LOOPS
PACIFIC
REMOTE
ACCESS
LOOPS
PERCENT
0
10
20
30
40
50
60
70
80
90
100

Figure 2.3-30

The data on amplitude response and group delay response of the lines was obtained by taking a photograph of the Halcyon display of these characteristics. These photographs are included in the report so that a comparison can be made with standard specification values. Each of the photographs was compared with V1, V2, S1, and S3 specifications and the tightest specification met was recorded for that call in the tables in Appendix C.

It should be noted that operation on data grade lines conditioned to S3 specifications will not necessarily yield a response meeting S3 specifications since the call may involve several circuits. This is emphasized in loop-around calls, and is also true of standard calls. The S1 specification is a user end-to-end specification for data grade lines and is supposed to take this into account; however, any attempt to specify end-to-end performance must imply a limitation in the number of sequential circuits involved. It is the individual circuits that are actually checked against the specified characteristics.

Tape recordings were made on virtually all calls. The recordings usually consisted of an introduction followed by a recitation of IEEE test sentences listed in Appendix E. The test sentences were normally played from a prerecorded tape but were sometimes read by the person at the transmitter site. The quality of the recordings from the prerecorded test tape was lower than that when the test sentences were read directly into the CVSD. This probably indicated a problem in the recorder - CVSD interface. Requests concerning these tapes should be addressed to RADC/DCLD, Griffiss AFB NY 13441.

2.4 Test Procedures

This section describes the methods used for making connections to the lines, dialing the test connections, tracing the circuit routings, and also covers the equipment setup and measurement procedures.

2.4.1 Connection Procedures

Connections were normally made to the network from either an AUTOVON or secure voice switch. The line access was by means of an extension from a secondary board or a test board. Connections for the testing were performed in several ways depending on the exact type of circuit to be established. For one-way calls the other location was simply dialed in the normal manner. For IST loops the switch loop-around numbers were utilized. For access line loops served by the originating switch, the loops were normally established by requesting a loop-around from Tech Control at the desired location. For remote access line loops, i.e., those served by a foreign switch, the procedure was slightly more complicated. Here it was necessary to patch around the echo suppressors at the switch serving the access line to be tested. Once this was done the loop at the remote access point was established at Tech Control or a test board in a similar manner to the local access line loops.

In order to establish the routing of the calls, a test tone was placed on the line and personnel at intermediate switches were requested to find the incoming and outgoing circuits with the tone. Normally the identification received was in the form of a Command Communications Service Designator (CCSD) number or equivalent, although in some cases group and channel number information was obtained directly.

2.4.2 Equipment Setup

A block diagram of the test setup is shown in Figure 2.4.2. The transmit line was arranged so that it could be switched to either the modem transmitter, the line tester transmitter port, or a quiet termination. The receive line was connected in parallel to the modem receiver and to the line tester receive port. The modem included a terminating resistor, but the line tester was operated in a bridged mode so that only a single termination was presented to the line.

The modem includes a pseudorandom pattern generator in the transmitter and a second identical pattern generator in the receiver. The receiver sequence generator was automatically synchronized during the modem training process. Subsequently, a bit-by-bit comparison was made between the receive data and the receive sequence generator, with mismatches indicated by error pulses. These bit error pulses were brought out of the modem and applied to the bit error rate counter. The modem also produced two other signals used for analyzing performance. The analog error at the equalizer output was brought out and monitored on a true rms voltmeter. Also, the equalizer weights were converted to analog form and brought out for monitoring on a second true rms voltmeter. It was hoped that the equalizer weight measurement would provide an overall measure of line filtering, but no strong correlation was observed.

The analog line parameters were measured with a Halcyon Universal Test System, Model 520B. This unit provided test of the standard analog parameters in the manner described in the next paragraph. In addition, the unit was modified to bring out the phase jitter signal. This phase jitter signal from the internal phase detector was routed to a low frequency spectrum analyzer to provide data on the spectrum of the jitter components.

For the transmit end of the one-way tests, only the transmit portion of the modem and the line tester were utilized.

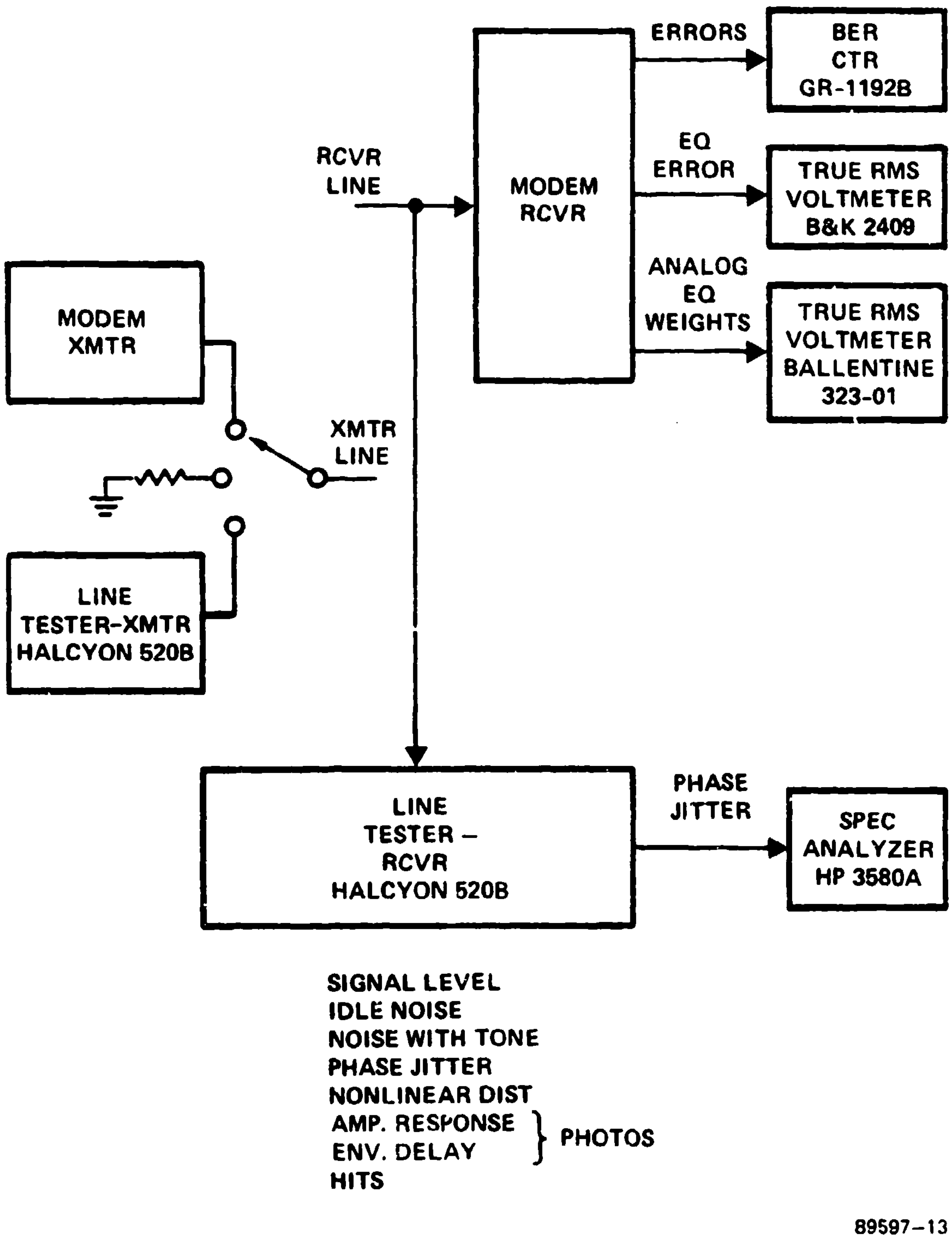


Figure 2.4.2. Modem Line Test Setup

2.4.3 Measurement Procedures

This section describes the methods used for reading and recording the various modem performance and line parameters.

2.4.3.1 Bit Error Rate

The bit error rate was measured using the internal pattern generators in the modems as described above. Normally, error rate at 16 kilobits was measured by recording the count in 10-second periods. Usually five of these 10-second error counts were made in each mode. At 8 kilobits the bit error rate was recorded in a manner that provided an estimate of block throughput. This was done by reading the error count in 1-second counting periods. Normally a total of 100 1-second counts was observed and all nonzero counts were recorded. With this set of measurements, the overall bit error rate as well as the block error rate (for 8000 bit blocks) could be calculated from the same data.

2.4.3.2 Signal-to-Noise Ratio

Several different measures of line signal-to-noise ratio were made. The first was on the modem line signal .n which the receive level and the idle noise measurements were recorded and their ratio calculated to provide the signal-to-noise ratio. The noise with tone was measured by transmitting a 1 kHz tone and recording the signal level. The noise level was measured with the tone notched out.

2.4.3.3 Phase Jitter

The phase jitter was measured with the Halcyon by transmitting a 1 kHz tone and phase locking a second 1 kHz signal to the receive signal at the receiver. The phase detector output is filtered to produce the spectral components from 20 Hz to 300 Hz and this value displayed on the Halcyon's digital display. In addition this

phase detector output was brought out to an external connection so that it could be displayed and photographed on the low frequency spectrum analyzer. A calibration of this setup was performed by providing a known amount of phase jitter to the system (using an Axel line simulator).

2.4.3.4 Amplitude Response and Envelope Delay

These measurements are performed in the Halcyon by sweeping appropriate signals across the band and displaying the resultant amplitude or envelope delay measurements on a cathode-ray tube (CRT) display. The CRT display was photographed for record purposes.

2.4.3.5 Nonlinear Distortion

Nonlinear distortion is measured in the Halcyon by transmitting two pairs of test tones, one centered at 860 Hz (Frequency A) and the second centered at 1,380 Hz (Frequency B), with a total power equal to the data level. The second order distortion products are measured by observing the power in the two bands of B + A and B - A. The third order distortion products are measured by observing the power at the frequency 2B - A. As a test for the effect of noise on these readings the B tone pair is removed and the power of the A tone pair is increased by 3 dB. An additional set of second and third order harmonic product readings are made and a correction factor is applied to minimize the effect of signal-to-noise ratio on the measured nonlinear distortion.

This nonlinear distortion measurement technique is an industry standard, and is felt to give a more representative measurement than total harmonic distortion of a single tone.

2.4.3.6 Transient Measurements

The Halcyon performs transient measurements by transmitting a 1 kHz tone at the data level. Simultaneous measurement of gain hits, phase hits, impulse noise above three thresholds, and dropouts are performed. Gain and phase "hits" are "rapid" gain or phase changes which last 4 milliseconds or longer. The impulse noise counter is inhibited when a gain or phase hit occurs. A dropout is defined as a reduction of 12 dB or more in level, lasting for longer than 4 milliseconds. All other counters are inhibited when a dropout is detected. The normal thresholds utilized for these transient measurements were ±3 dB for the gain hit threshold, 20° for the phase hit threshold and 59 dBRNO for the "O" impulse threshold. The other two impulse noise thresholds were 4 dB and 8 dB respectively above the reference setting. The transient counters are capable of counting at rates of up to seven events per second. The transient measurements were counted over a 5-minute period.

2.5 Comparison of Modes

One of the major objectives of the test program was to evaluate several modes of the modem on the actual networks to establish the optimum mode for operational purposes if satisfactory performance was achieved. Paragraph 3.3 discusses some of the process which led to the selection of the four modes that were tested. Paragraph 3.4 describes the four modes. In this section the comparative results obtained from the modes are presented. The modes are designated as 16-110, 16-130, 16-111, and 16-C. The first two modes (16-110 and 16-130) represent hardware of the same complexity as that involved in the original breadboard. The last two modes would require slightly less hardware to implement.

Figures 2.5-1 through 2.5-9 present the 16 kb BER performance of the four modes in the nine different categories of calls presented in Paragraph 2.2.1. In all cases, anomolous error counts have been disregarded in calculating the error rate. Mode 16-110 (the normal mode) was used for all of the curves in Paragraph 2.2.1.

With the exception of the European IST loops the BER performance can be seen to be very similar for all four modes. Actually the largest performance difference noted between modes was in the area of sync misses. On some channels where very poor 16 kb error rate existed, mode 16-C could not achieve sync although 16-110 and 16-130 provided reliable sync. As a whole it was felt that 16-110 did provide the best overall performance although all modes were acceptable.

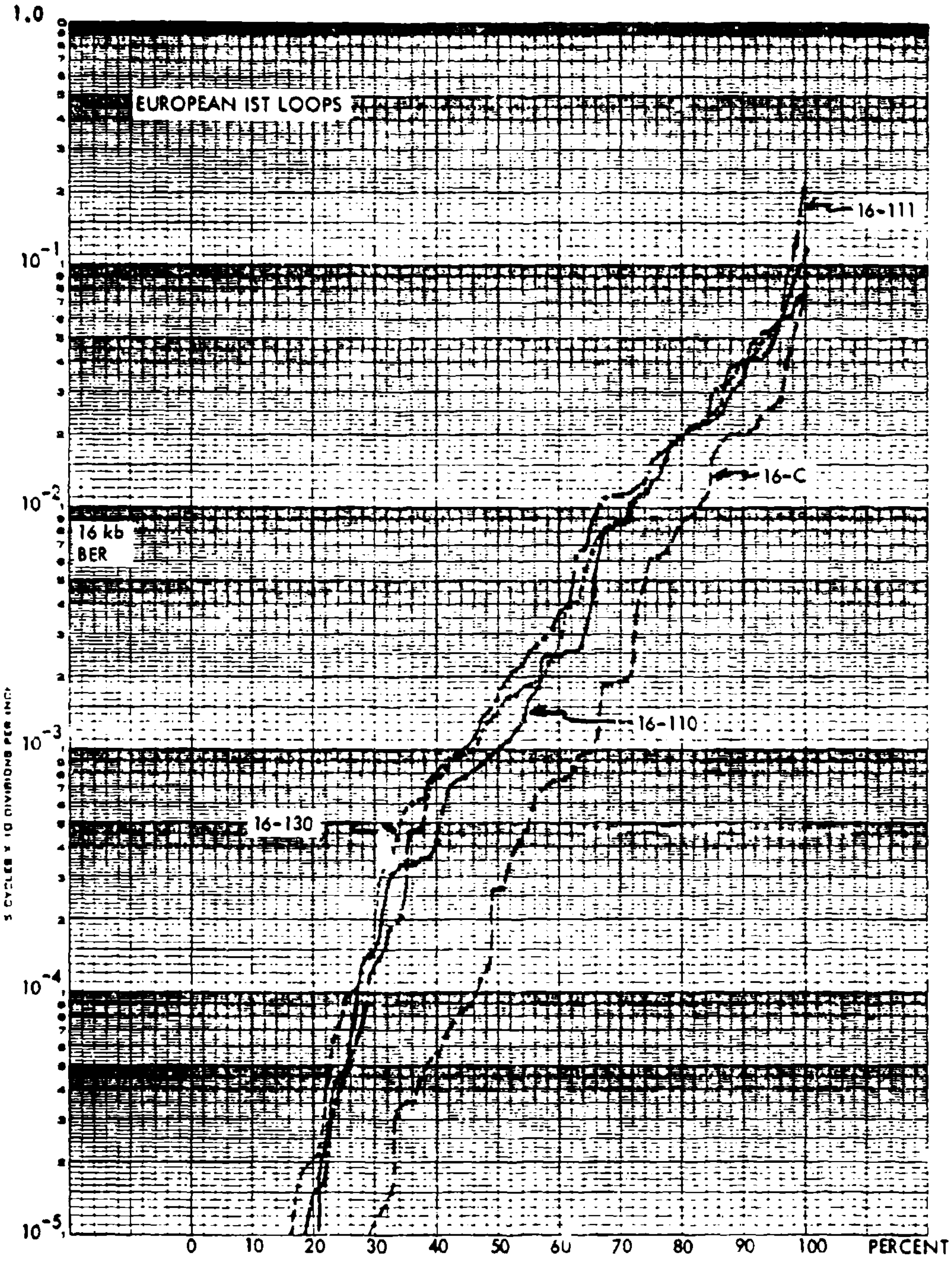

EUROPEAN IST LOOPS
16 kb
BER
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
16-111
16-C
16-110
16-130
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.5-1

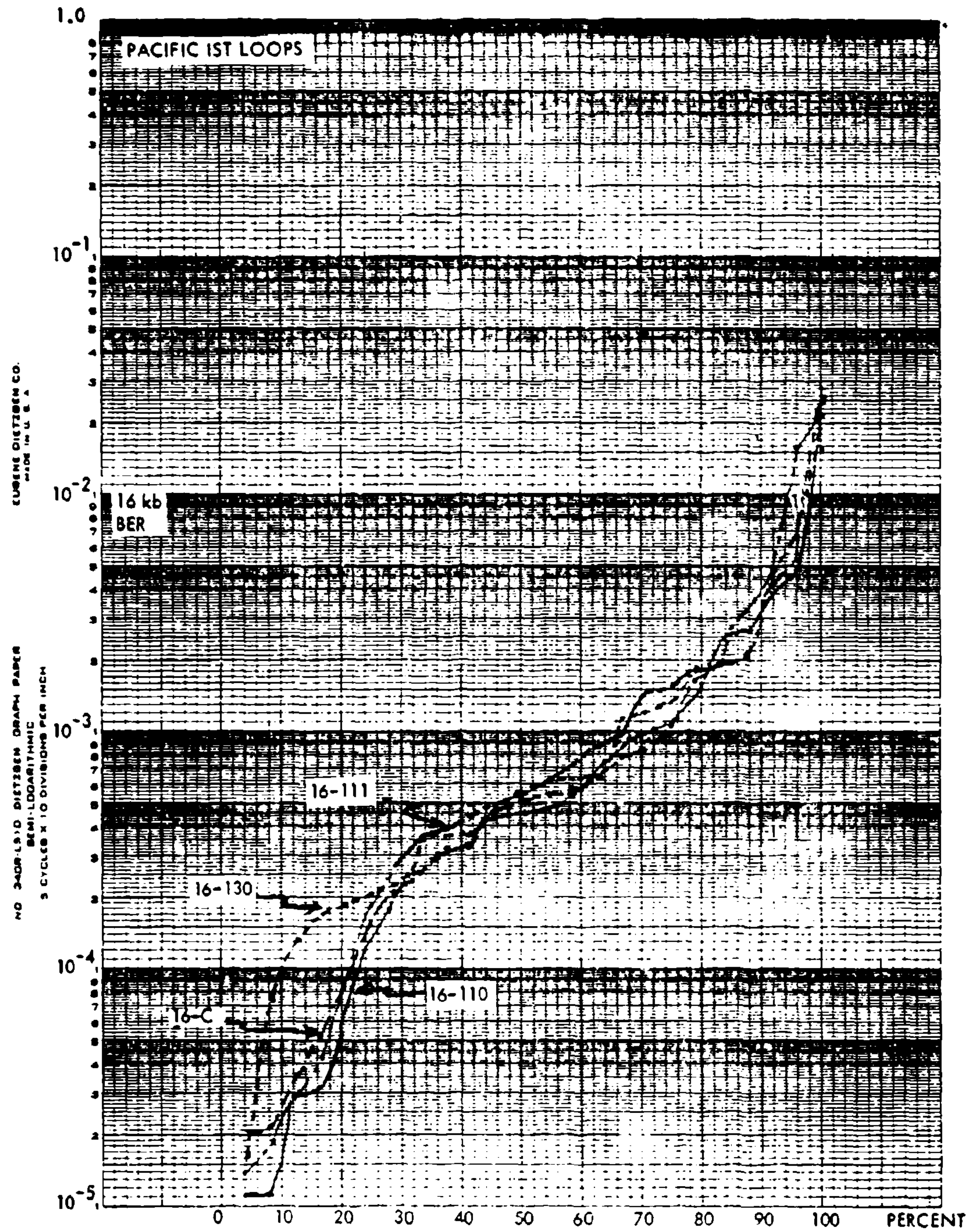
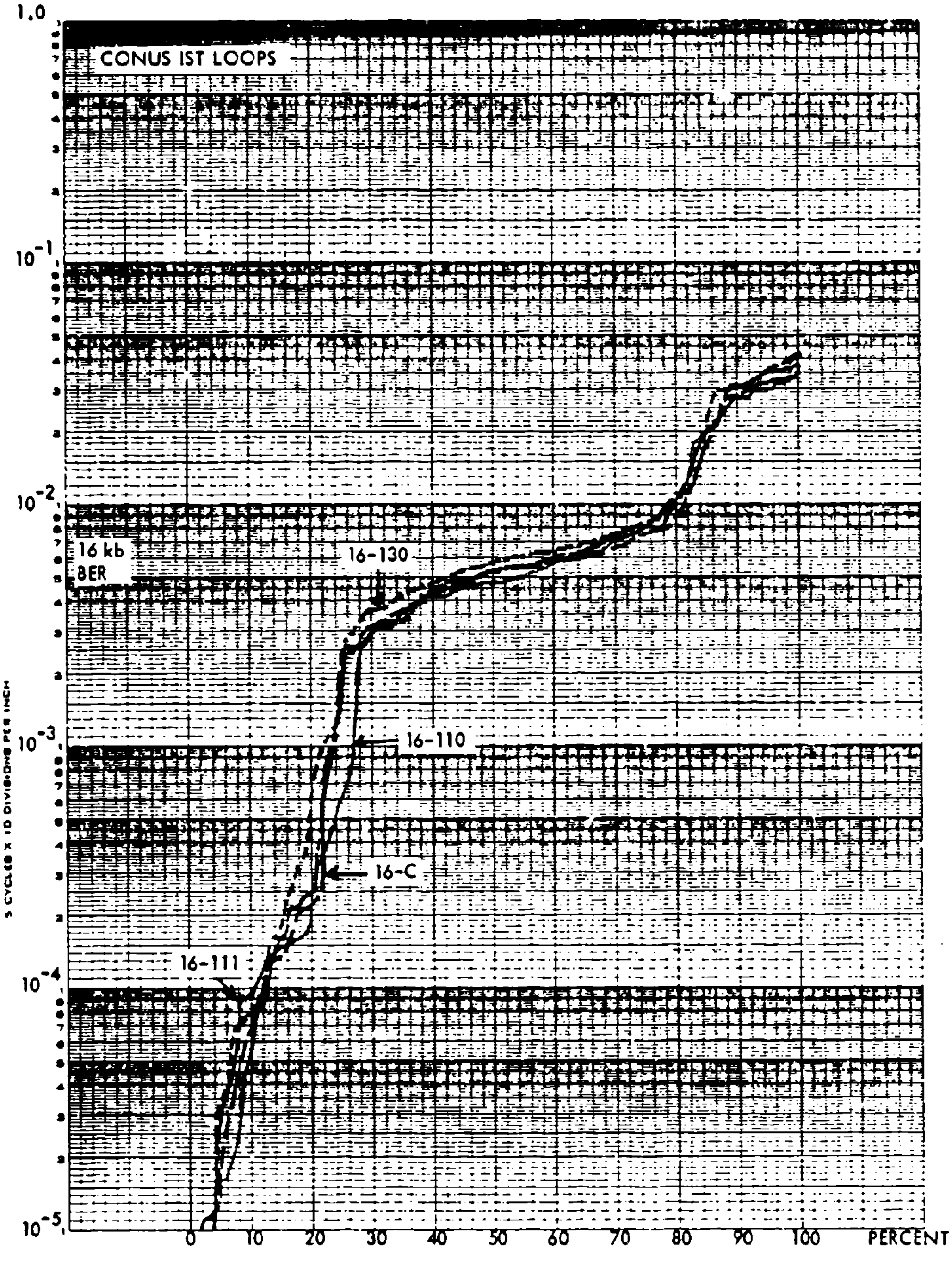

1.0
PACIFIC IST LOOPS
10^-1
10^-2
16 kb
BER
10^-3
16-111
16-130
10^-4
16-110
16-C
10^-5
0
10
20
30
40
50
60
70
80
90
100
PERCENT
NO 340R-L310 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
5 CYCLES X 10 DIVISIONS PER INCH
EUGENE DIETZGEN CO.
MADE IN U.S.A.

Figure 2.5-2



1.0
CONUS IST LOOPS
10^{-1}
10^{-2}
16 kb
BER
16-130
10^{-3}
16-110
16-C
16-111
10^{-4}
10^{-5}
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.5-3

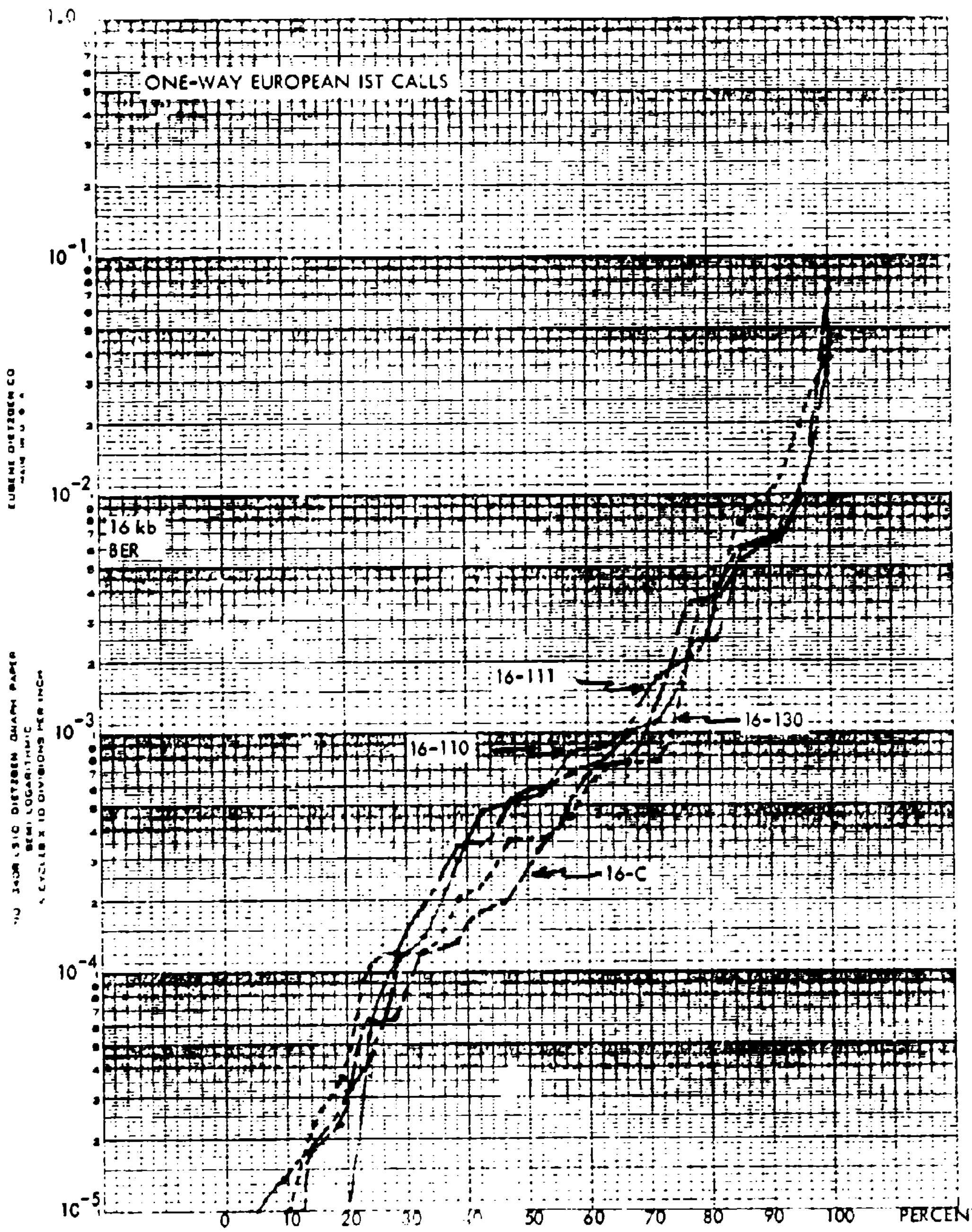
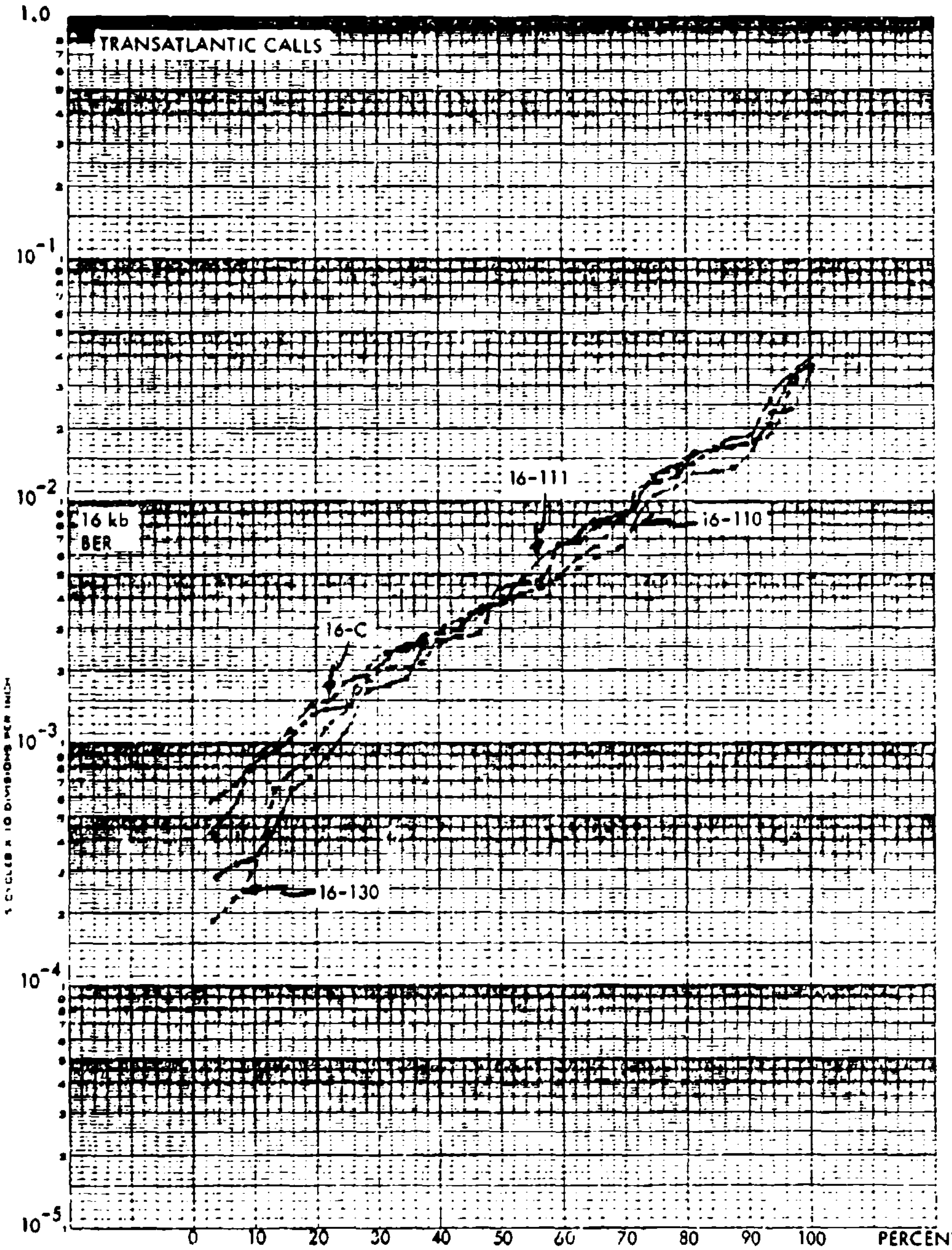
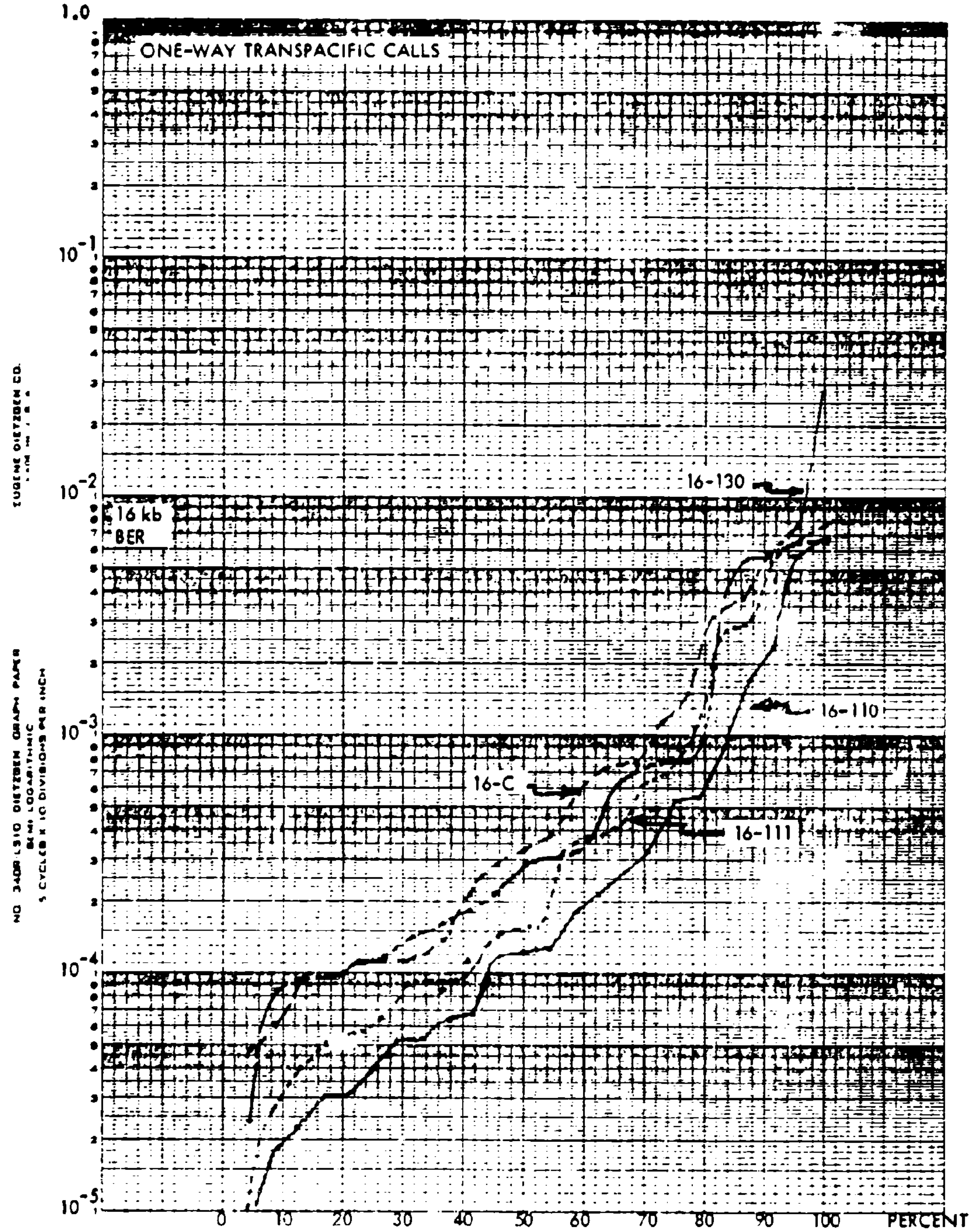

ONE-WAY EUROPEAN IST CALLS
16 kb BER
16-111
16-130
16-110
16-C
PERCENT

Figure 2.5-4



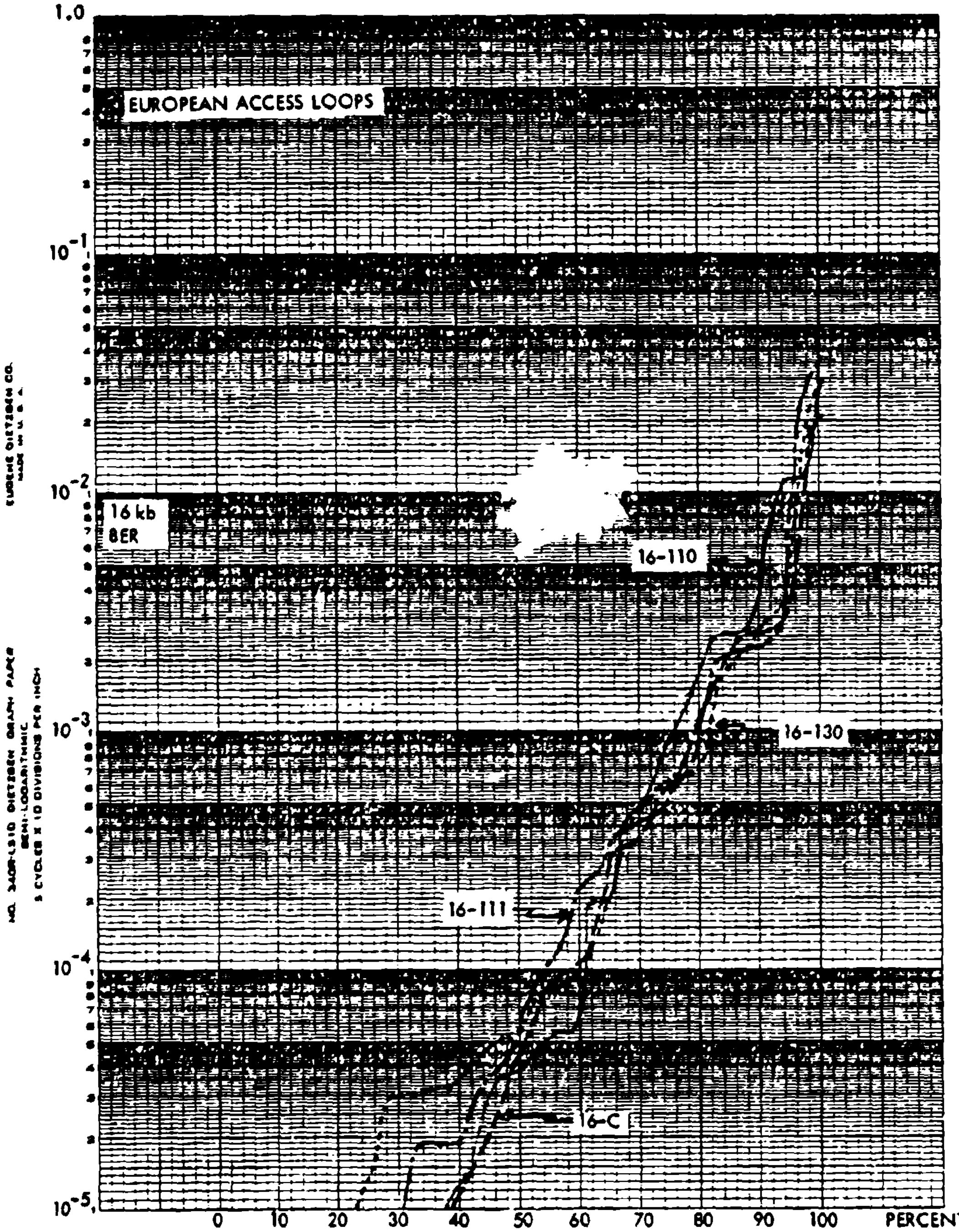
TRANSATLANTIC CALLS
16 kb
BER
16-111
16-110
16-C
16-130
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.5-5



ONE-WAY TRANSPACIFIC CALLS
16 kb BER
16-130
16-110
16-C
16-111
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.5-6



EUROPEAN ACCESS LOOPS
16 kb
BER
16-110
16-130
16-111
16-C
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0 10 20 30 40 50 60 70 80 90 100 PERCENT

Figure 2.5-7

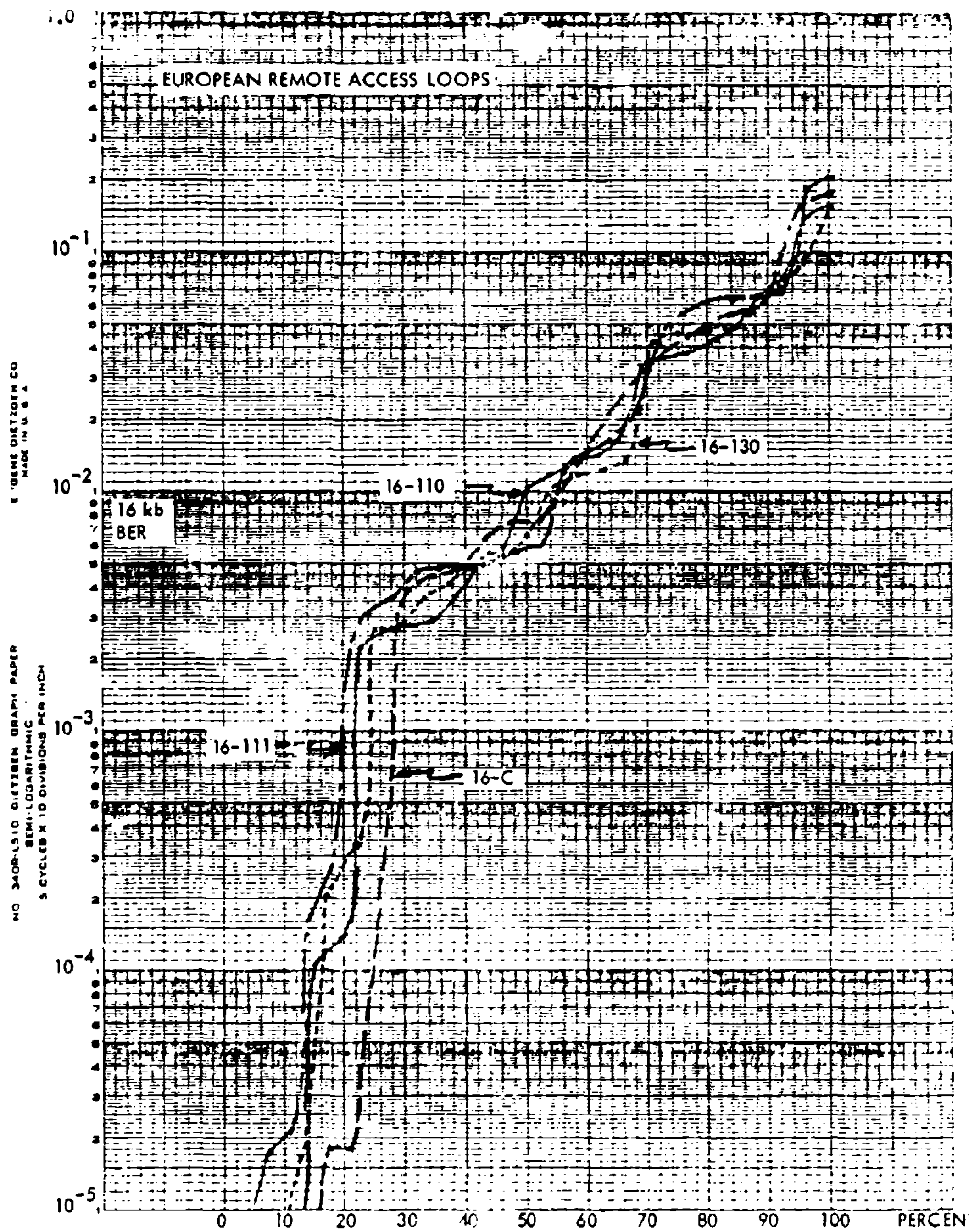

EUROPEAN REMOTE ACCESS LOOPS
16 kb
BER
16-130
16-110
16-111
16-C
1.0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.5-8

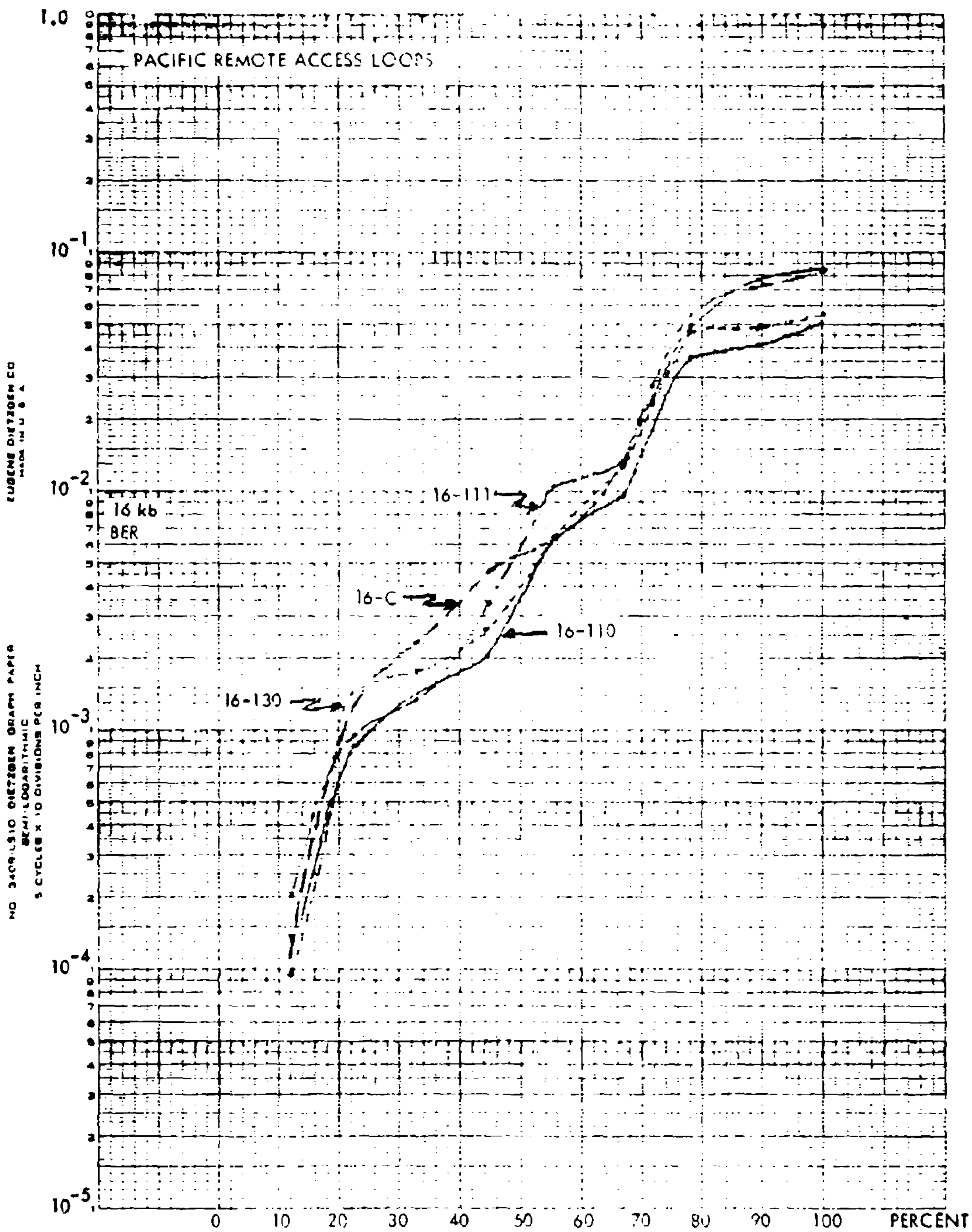

PACIFIC REMOTE ACCESS LOOPS
1.0
10-1
10-2
10-3
10-4
10-5
16 kb
BER
16-111
16-C
16-110
16-130
0
10
20
30
40
50
60
70
80
90
100
PERCENT

Figure 2.5-9

3.0 MODEM MODIFICATIONS

This section describes a set of modem hardware and firmware modifications made prior to the tests. These modifications were designed to package the Breadboard for the rigors of travel and field testing, and to improve performance in certain areas identified by previous tests.

3.1 Repackaging

Prior to European testing, the modem and modem transmitter were repackaged to permit the equipment to be easily and reliably transported as well as set up and operated with a minimum of effort. The basic modem was encased in a 7 by 19 by 30.5 (H X W X D) inch chassis. The modem processor along with the power supplies for both the modem and processor were encased in a 7 by 19 by 16 inch chassis. The separate transmitter and its power supply was encased in a 7 by 19 by 16 inch chassis. All controls and input/output connections necessary for operational testing were installed on the front panels of the units. Blowers were installed in each of the three units to provide adequate cooling. The repackaging effort resulted in a complete modem (receiver, transmitter, processor) being housed in two chassis. The separate transmitter was encased in one self-contained unit. After repackaging, the units were tested to ensure that the overall performance had not been adversely affected by the change in mechanical configuration.

3.2 Look-Up Table Investigation

In the original study program a technique for combating memoryful nonlinearities was devised which employed a memory which was trained to provide appropriate corrections for each transmitted pattern. A detailed description of this approach is given in the Bibliography Reference 1, and will not be repeated here. Although computer predictions for this technique indicated a noticeable improvement in performance for this approach when nonlinearities were present in the channel, the actual

equipment had produced no gain in performance when the look-up table was employed. It was an objective of this program to investigate this discrepancy and determine whether the look-up table approach could be modified to provide a performance advantage prior to the European testing.

Analysis of the difference between the assumptions present in the computer prediction and the actual hardware operation indicated that the likely problem was that the look-up table in the hardware used actual symbol decisions to provide the address while training, whereas the computer analysis had presumed perfect decisions. Since the bulk of the errors in channels with nonlinearity problems are irreducible errors it can be deduced that the table could not be expected to train properly when operating upon decisions rather than the actual transmitted signal as the basis for the table address. Consequently, the modem was modified to allow look-up table training during the normal training mode and an ideal reference, available in the hardware, was supplied to the processor so that it could be used as a basis for the address.

No perceptible performance improvement was noted in this case even when extended periods of time (30 minutes) were used to train the look-up table. Close examination of the received data (on an oscilloscope) during the training mode indicated that the errors for a fixed pattern had very little bias relative to their variance even when nonlinearity was the only disturbance present on the simulator. Thus, it appeared that the favorable predictions predicted by the computer model were due to a difference in the exact modeling and were not available to the hardware. Hence the look-up table approach was dropped. None of the tests reported in this document employed the look-up table.

3.3 Other Processor Modifications

Several other modifications to the processor were incorporated in the modem between the initial contract and the test results reported in this document.

During the initial study effort eight phase measurements were used in the phase-tracking algorithm. Although the computer prediction indicated that this was the best choice, this prediction was based upon a model of phase jitter that was felt to be questionable. Hence an attempt was made to provide the processor with the capability of switching manually between eight and four phase measurements. Time, however, did not allow completion of this activity prior to completion of the initial contract. This effort was completed prior to the testing reported herein and accounts for two of the modes that were tested as is discussed in Paragraph 3.5.

Although the phase tracking algorithm had worked quite adequately in the tests conducted at the end of the initial contract, it was anticipated that the phase jitter present in the European tests would be more severe than that existing on the CONUS lines. Specifically it was anticipated that lines with a large amount of low frequency jitter might be present. In this case the differential nature of the data would make the bit error-rate insensitive to this jitter. However, the initial equalizer training might be affected since the phase tracking loop used during equalization is very slow and would likely not be able to track this jitter. Simulation in the laboratory of large quantities of low frequency jitter indicated that this might be a problem.

Several approaches to using the processor to supply the equalization error signals during training were investigated. None of them solved the problem completely but the best approach located was one which switched modes half way through the eight frames of equalizer training. The training mode for the first four frames was that previously used except that the phase loop external to the processor to track the incoming signal phase was disconnected. At the end of four frames the phase loop was switched to utilize the X-Y reference algorithm in the processor as the basis for the equalizer error signal. The switching between modes was set up to be accomplished manually from a front panel sense switch since the modification required in the processor to automate this activity was too extensive to be done prior to the European tests. This switched mode

was one of the four tested.

Since modes which did not employ the external phase tracking loop could potentially reduce the amount of hardware, a switch was incorporated to allow disabling of this loop. The fourth mode tested was one in which all of the operations were the same as that developed in the previous program except that the external phase loop was disconnected.

3.4 Training Sequence Modifications

The receiver training sequence was modified to increase synchronization reliability. It was observed during line tests that the receiver would occasionally fail to recognize the sync pattern in the eight-frame training sequence. This caused the receiver to prematurely terminate the training sequence, resulting in the inability to pass data. The first sync, however, was detected whenever the receiver recognized the carrier burst at the beginning of the training sequence. Therefore, a means to prevent the synchronization logic from missing intermediate sync patterns was needed.

The present configuration of the synchronization logic contains circuitry which prevents the receiver from prematurely terminating the training sequence. This modification is implemented by the addition of a frame counter to the synchronization logic. The frame counter is initialized by the recognition of the first sync pattern. The frame length timer outputs a carry pulse to the frame counter at the end of each received frame of sync and training. After seven frames have been received, the frame counter releases the end of sync detect circuit. This enables the end of sync detect circuit to sense the absence of sync at the end of the eighth frame. The receiver then goes through the original freeze-weight and data modes. The modified synchronization logic will still permit training sequences longer than eight frames. When the receiver is in the continuous sync and training mode, the end of sync detect circuit is disabled. When the receiver is switched back to the normal mode, the end of sync detect circuit is reenabled after seven frame times. A modified block-diagram is shown in Figure 3.4.

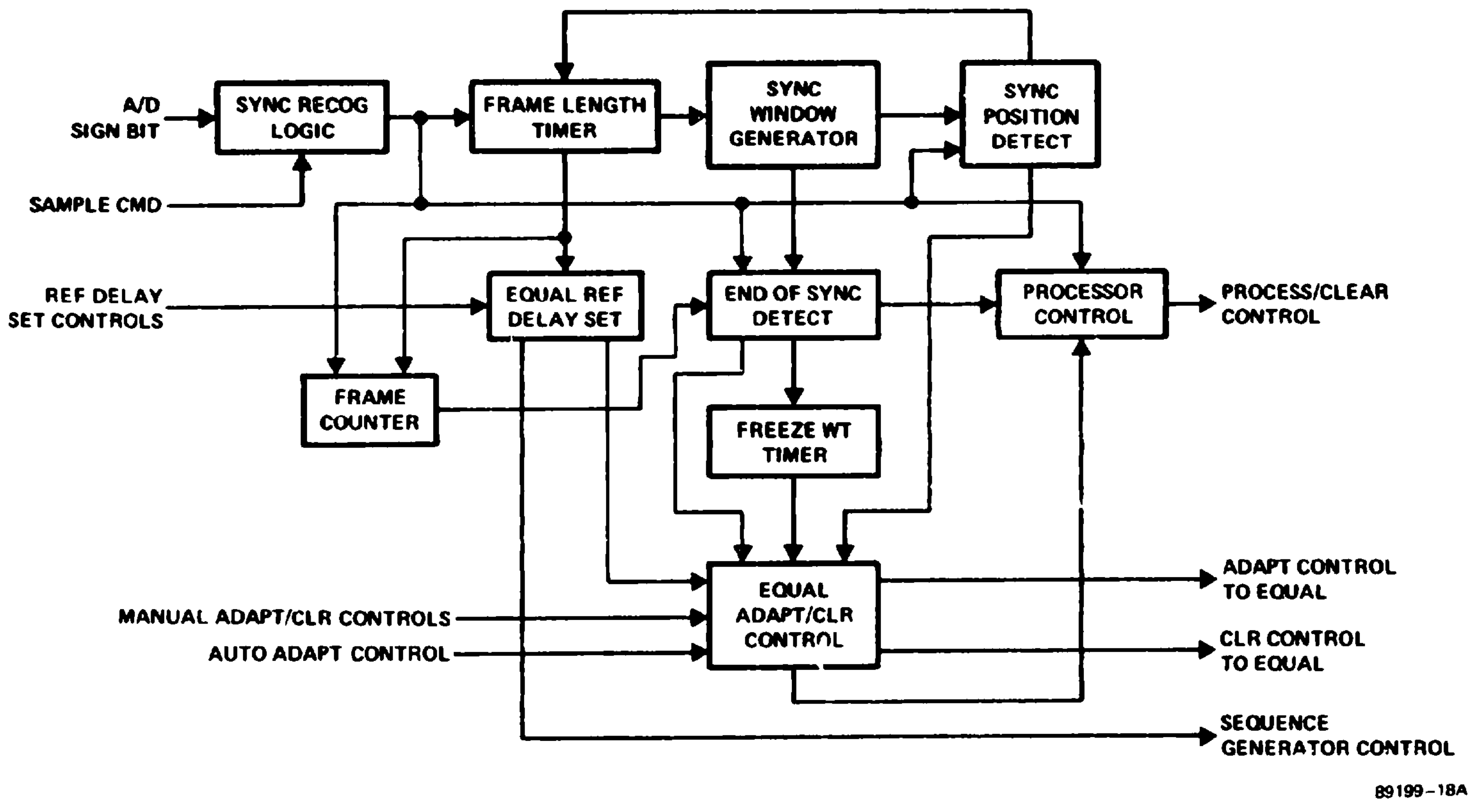


Figure 3.4. Modified Synchronization Logic.

3.5 Description of Modes

The four modes tested on the AUTOVON network will be briefly described in this section. The basic differences between the modes lies in three areas. These are:

a. The use of either four or eight samples in the processor phase tracking algorithm during the data operation. This does not affect operation during the normal training operation.

b. Use of the external phase tracking loop. This applies to both the training and data operations.

c. Source of the X-Y errors for the equalizer during the training operation selected from the normal subtraction of the estimate from the reference or whether they are obtained from the processor algorithm used during data transmission. The four modes tested are shown in Table 3.5 along with the configuration in these three respects.

Table 3.5. Mode Configurations

Mode	8 or 4 Samples	External Phase Loop	Source of X-Y Error for Equalizer During Training
16-110	8	Connected	Normal Subtraction
16-130	4	Connected	Normal Subtraction
16-111	8	Disconnected	Normal Subtraction
16-C	8	Disconnected	Normal Subtraction for First Four Frames Processor Algorithm Last Four Frames

4.0 KEY GENERATOR TESTS

This section describes a series of interface tests with the modem and two types of encryption/decryption key generators, TSEC/KG-13 and TSEC/KG-34. The purpose of these tests was to determine at what point key generator synchronization would become a problem. This is an important consideration since the modem is able to synchronize and operate at high bit error rate conditions, and CVSD equipment such as the HY-11 is able to provide intelligible, albeit noisy, speech at high bit error rates. It should be noted that the use of "self synchronizing" key generators, with the attendant error multiplication, would significantly reduce the percentage of lines providing usable voice quality.

4.1 Test Setup

The test setup was as shown in Figure 4.1. The transmit portion of the key generator under test was connected between the HY-11 CVSD transmitter and the modem transmitter data input port. Similarily, the receive port of the key generator was connected between the modem receiver data output port and the HY-11 data input port.

The line simulator signal-to-noise ratio was adjusted to obtain the desired bit error rate from the modem. The a series of keyer synchronization attempts was made, using the controls on the key generator. Synchronization was verified by monitoring the output of the receive portion of the HY-11. In the absence of synchronization, this output consists of a high level noise. Normally, 20 synchronization attempts were made at each bit error rate.

4.2 Results

The results for the KG-13 are shown in Figure 4.2-1, in the form of curves of sync probability vs bit error rate. The "modes" (4,8,16,32) have to do with the length of synchronization pattern employed by the key generators. The numerically

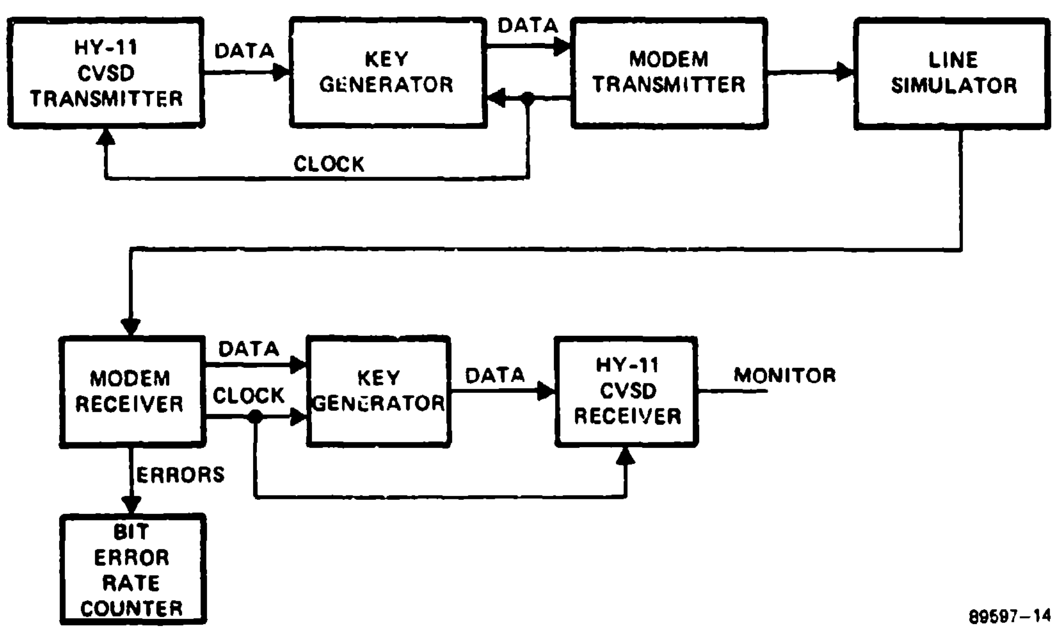


Figure 4.1. Key Generator Test Setup

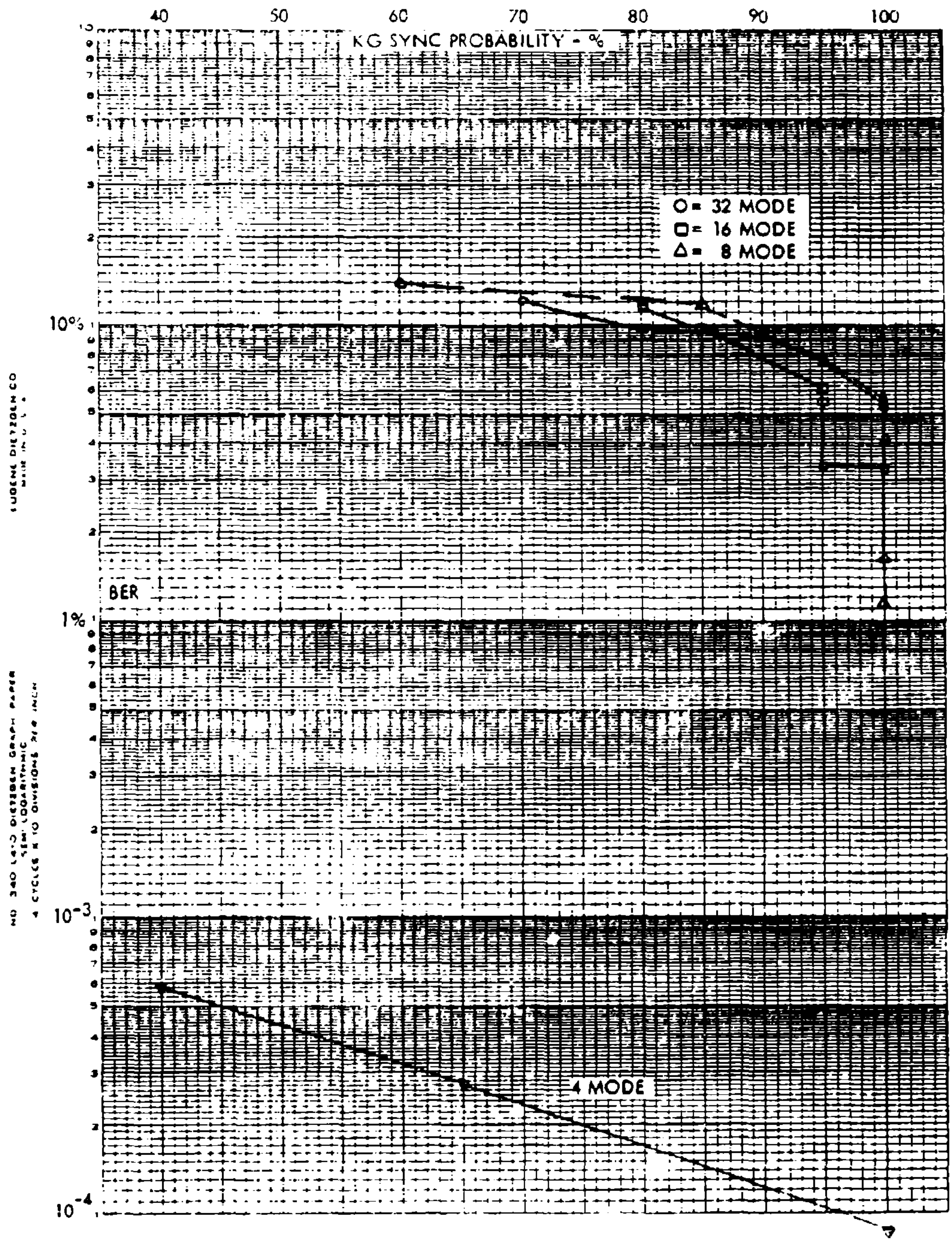


Figure 4.2-1. Sync Probability Versus Bit Error Rate KG-13

larger modes require longer synchronization time, but at 16 kb/s the longest sync time is less than 1 second, and is not significant relative to modem training time. As seen in the figure, all modes but "4" are similar in performance and provide 90 percent sync probability with bit error rates up to 8 or 10 percent. This is a virtually unusable bit error rate for CVSD voice, so the KG-13 would not limit system performance if the "4" mode was avoided.

The results for the KG-34 are shown in Figure 4.2-2. The performance is similar or slightly better, so the same conclusion would hold.

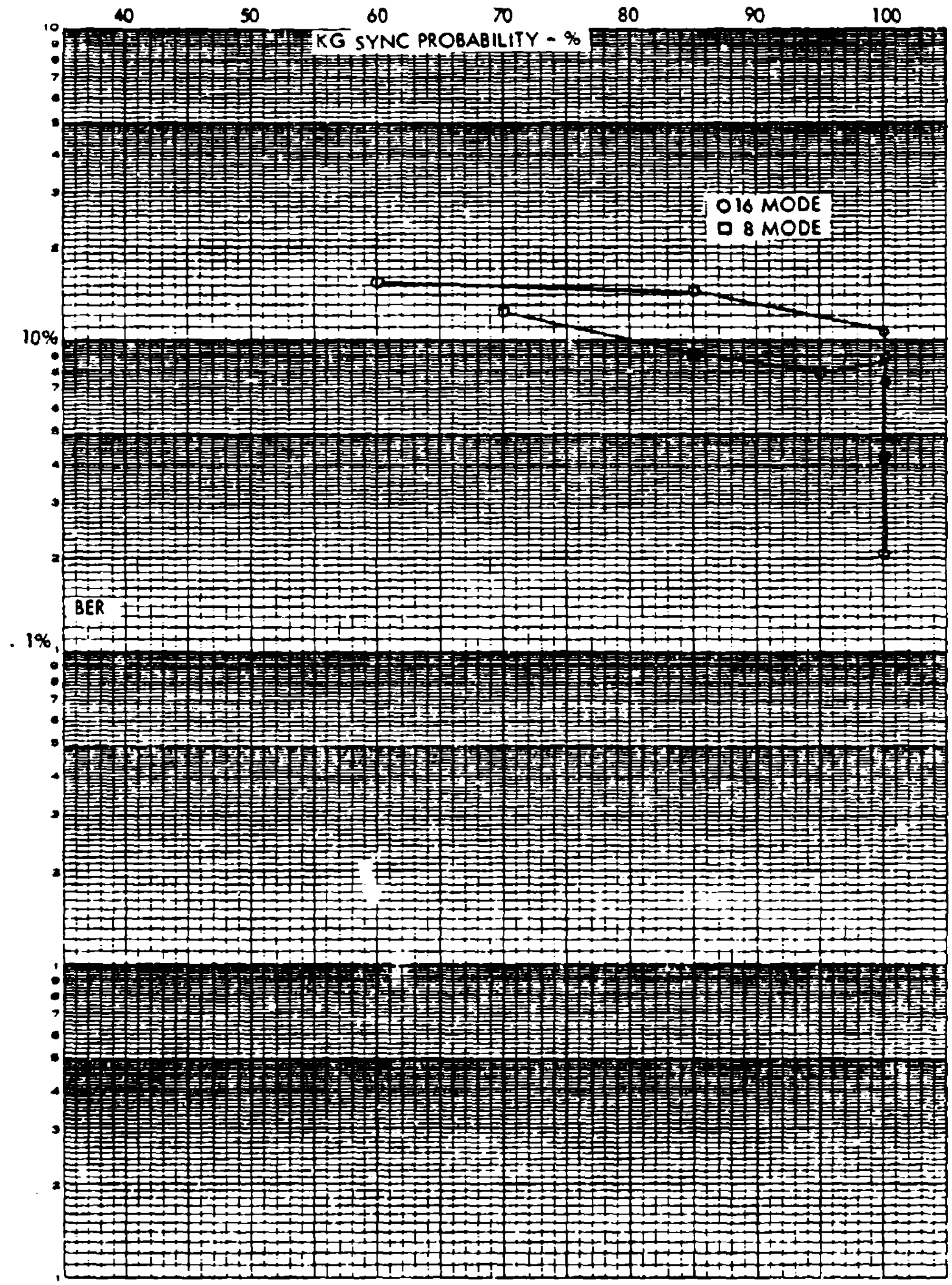


Figure 4.2-2. Sync Probability Versus Bit Error Rate KG-34

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from the results of the efforts described in this report:

a. The design of the 16 kb modem is sufficient to provide for adequate voice quality over the existing AUTOVON network in any of the uses envisioned presented in Section 2.0 of this report.

b. Digitization of segments of the network are not likely to degrade the voice service supplied.

c. All four modem modes tested provide good performance. Mode 16-110 provided slightly better results than the other three.

d. The only type of line disturbances observed in the testing which caused significant performance disturbances were fades of tropo links (predominantly in Europe) and harmonic distortion (in CONUS).

The following recommendations are made:

a. Research, development, test, and evaluation units should be procured.

b. These units should be tested in an operational configuration associated with AUTOSEVOCOM switches to provide service similar to that presently available with the 9.6 kb/s modem.

c. Further investigation should take place to determine modem algorithms which would improve performance in the presence of fades and harmonic distortion.

d. The use of D conditioned lines should be considered in cases where access lines have severe harmonic distortion.

e. Line models for the European network should include the effect of fades.

APPENDIX A

NETWORK DESCRIPTION

A.0 General

A good deal of effort was expended during the initial phases of the program to understand the AUTOVON network as it presently exists as well as its anticipated configuration after the planned conversion to digital traffic. It was felt that an understanding of these facts would allow a better test plan to be created and would result in a better interpretation of the test results. This appendix presents a brief description of the "picture" of the network which was obtained from these efforts. The principal documents used in this effort are listed in the Bibliography References 2-11.
Reference 12 was used to verify CCSD numbers in connection with circuits tested.

It should be emphasized that it is not the intent of this appendix to present the reader with a complete description of the AUTOVON network. Rather it is intended to present the aspects of the network that appeared to be significant relative to the 16 kb modem test program and its potential use in the future network.

A number of the documents used to extract the detailed data on the European and Pacific networks were not consistent in all matters. This is undoubtedly due, at least in part, to the dynamic nature of the network. Hence data presented relating to quantities of circuits of different categories should be taken as approximately correct for the time period of the test, and not as an exact indication of the network at the time this report is being read.

This appendix first presents an overall discussion of the world-wide AUTOVON network, the plans for change, and roles that the 16 kb modem might play in the future network. This is presented in Paragraph A.1. Paragraph A.2 provides detailed data on the European network which was used to determine the network coverage. Paragraph A.3 presents similar data for the Pacific AUTOVON network.

A.1 The World-Wide AUTOVON Network

The present network can be thought of as a composite of four different telephone networks, These are the networks in Europe, Asia, the Caribbean and the Continental U.S. Each of the three overseas networks are connected to the CONUS network through trunks between gateway switches. Within a particular network there are a number of AUTOVON switches (10 in Europe, five in Asia, one in the Caribbean and 70 in the CONUS). A connection between these switches will be referred to in this document as an IST. These switches serve a large number of subscribers who are connected to the AUTOVON switches by access lines. Many of the AUTOVON subscriber lines go to a secondary switch (PBX) located at a particular military installation. Thus, individual telephone subscribers at a base are tied into the PBX and can dial an AUTOVON switch through the PBX. In addition to the PBX access lines there are a number of access lines which go directly to a subscriber. These lines generally share the transmission facilities that are used to provide PBX access lines to the location of the subscriber, but these access lines are not switched by the PBX. The access lines presently used for AUTOSEVOCOM are of this nature.

All of the IST and access lines are four wire circuits. It appears that most of the subscriber lines off PBX switches are two wire connections since most PBX switches are two wire switches. Thus, the conversion between four and two wire circuits normally takes place on the AUTOVON side of the PBX switch.

The circuits are conditioned as voice grade (V1 and V2) or data grade (S3) circuits. The IST's contain circuits of both categories which are selected by the switch based upon a dialed prefix to the number. A data grade prefix will cause the switch to select a data grade circuit or provide a busy signal. A voice grade prefix (no prefix) will cause the switch to first search the voice grade circuits and if the voice grade

circuits are busy, the switch may select a data grade line. In Europe all of the AUTOVON access lines are data grade and most, if not all of the PBX access lines are voice grade.

At present the 2.4 kb AUTOSEVOCOM signals are passed through regenerators at each gateway switch when the signals are to be sent from one of the four networks to another of the four networks. The regenerators convert the analog signal to a bit stream which is then used to produce a new analog signal. Consequentially, final bit error rate is the sum of the bit error rates obtained in each of the segments. This provides less overall degradation than that which would occur if the signal were not regenerated. In addition the crypto key is changed at the CONUS gateway locations which would necessitate the regeneration even if the signal degradation would not. The exact configuration of the 9.6 kb AUTOSEVOCOM signals was not determined with certainty. At present there are relatively few 9.6 kb modems in use.

The present network is almost exclusively an analog network. In Europe the only digital links are those that were installed in the "FKV" project which provide digitized trunks between Hiedelburg, Vaihingen, Swetzengen, Koeningstuhl, and Stuttgart. No IST circuits transit these trunks at present; and since none of these locations are AUTOVON switches, no access lines use exclusively digital trunks. The conversion of the European network planned in the DEB Phase I project will tie the FKV trunks into trunks coming from Coltano, an AUTOVON switch , and hence will result in a number of IST's which will transit the digital segment. However, since a second switch is not involved, all IST circuits will still transit portions of analog trunks. Later phases of DEB will extend the digital network to England and result in a large number of IST circuits and access lines which transit the digital trunks. The present projections for the time frame of DEB Phase I would provide completion in the next few years. The succeeding phases of DEB will be implemented in the 1980's.

It should be noted that the plans, of necessity, involve digitization of the transmission facilities first, followed by installation of digital switches. No end-to-end digital service can be provided until digital switches are installed. Even then end-to-

end digital service will be available only when all switches and transmission links between the subscribers involved are digitized. This also needs to include all routings between these subscribers since means of obtaining alternate routing must be preserved. It would appear that the time frame associated with providing this type of service throughout the network is quite long although some subscribers may have this service in the reasonably near future.

The plans associated with AUTOSEVOCOM II are consistent with interfacing the digital network with secure digital signals. Again, however, the subscriber locations with this service available will be limited to those which can be connected by completely digital AUTOVON service.

Unquestionably, the conversion of a vast operational network such as the AUTOVON network in a manner that does not disrupt service during the conversion will be a complex and lengthy process. Therefore, interim measures aimed at either upgrading the secure voice quality during the conversion or easing the task of conversion should be considered as potential roles of a 16 kb/s modem. Permanent roles in cases where conversion is not possible, or where the cost of digitization is too great, should also be considered.

Three general categories of usage appear consistent with the existing network and the plans for conversion. These are:

a. Upgrading the voice quality compared to that presently available from the existing 2.4 kb/s vocoders and the 9.6 kb/s CVSD units in present use in the AUTOSEVOCOM network. This implies that the modem signal is treated as analog by all of the switches in the network whether or not specific trunks may have been digitized.

b. Interfacing subscriber locations which do not have digital service with the digital network. This implies that the modem signal is treated as an analog signal only on the access lines connecting the subscriber to the digital switch, and at that point is converted to a digital signal for transmission over the digital network. This presupposes the existence of digital switches as well as digital trunks.

c. Handling 16 kb/s digital traffic over interswitch trunks which either cannot be digitized or which will not be digitized in the earlier phases of the digital conversion. Specific examples of this are undersea cables and other leased Telpak service. However, it would appear that on an interim basis, interswitch trunks requiring tropo hops and commercial satellite links also fall in this category.

A.2 The European Network

The 10 AUTOVON switches in the European network are connected by 22 link segments shown in Figure A-1. All of the interswitch traffic transits these links on circuits that may be patched at one of the locations shown. The circles in Figure A-1 indicate switch locations and the squares indicate nonswitch locations where at least one of the interswitch circuits is baseband patched. The segments are generally made up of several transmission links. The link designators are shown on Figure A-1. Segments involving only microwave LOS links are shown as solid and those involving tropo, diffraction or leased circuits are shown as dotted. Ten of the 22 segments require links that are not microwave LOS links. If these segments were taken out of the network, some switches could not be accessed and the flexibility of routing to the switches that can be accessed would be greatly impaired. Consideration of the geography associated with the tropo, diffraction and leased segments leads one to the conclusion that they cannot be reasonably replaced with LOS links. Hence the digitization of the

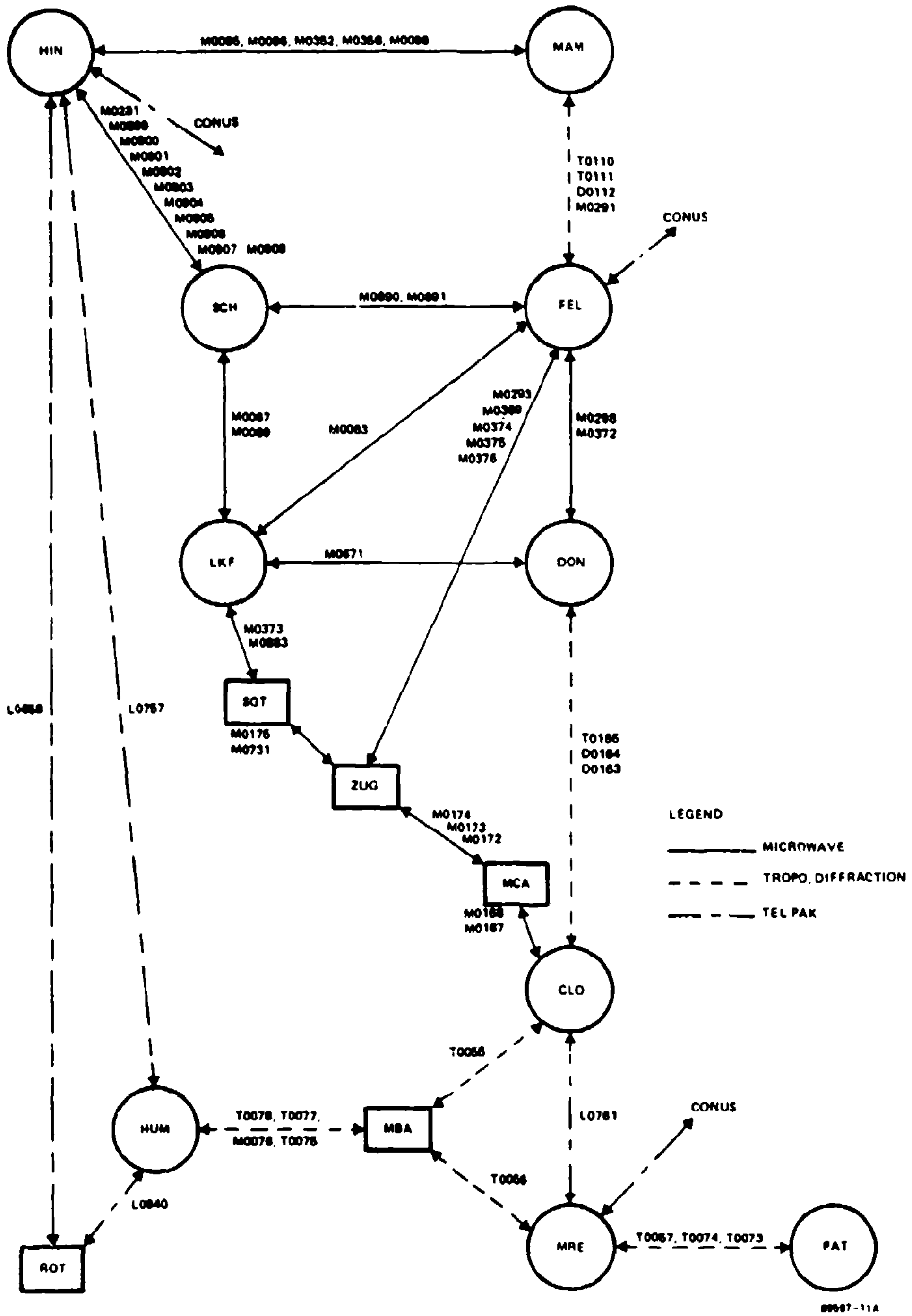


Figure A-1. European IST Network.

network will require some method of handling digital traffic over these links as well as over the LOS links, most of which are planned to be digitized in the DEB program. In all there are 40 microwave LOS links, 11 tropo links, four leased Telpak links and three diffraction links which handle interswitch traffic.

The network handling access line traffic is much more complex than that associated with the interswitch traffic. Figures A-2 through A-11 show the networks connecting each of the 10 switches with their subscriber locations. As before, circles indicate switches and squares indicate either subscriber locations or locations where baseband patches are present. Each of the subscriber locations has an indication of the number and type of subscriber lines coming from that location to the AUTOVON switch in question. The symbol, PX, indicates a PBX line, 4 W a four-wire line not going through a PBX, 4 WA a four-wire secure voice line, and PXA and PXX a line to a secure voice switch. As before the links transited in each segment are shown. The heavy lines, both solid and dotted, indicate IST links which appeared on Figure A-1. Solid lines indicate segments connected by either LOS links or government owned land lines. Dotted segments involve some other form of link. In addition dotted lines go to locations where interface with the public telephone circuits are used to supply subscriber service.

Table A-1 lists the total number of different subscriber locations for each switch and a breakdown as to how they are connected to the switch. The numbers under M indicate the numbers that involve only microwave LOS links. Under T are the numbers involving one or more tropo links. Under D are the number of locations requiring a diffraction link but no tropo hops. Under L are the number of subscriber locations which access the switch through leased Telpak service. The H column shows the number of subscribers involving a VHF or UHF LOS link. The number under PTT shows the number of subscribers using the public telephone services. As can be seen, 221 different routings are involved. Of those, 91 are connected by either LOS or government land line which should be relatively easy to digitize. Sixty-three involve tropo or diffraction links, and 67 involve commercial leased lines of some sort.

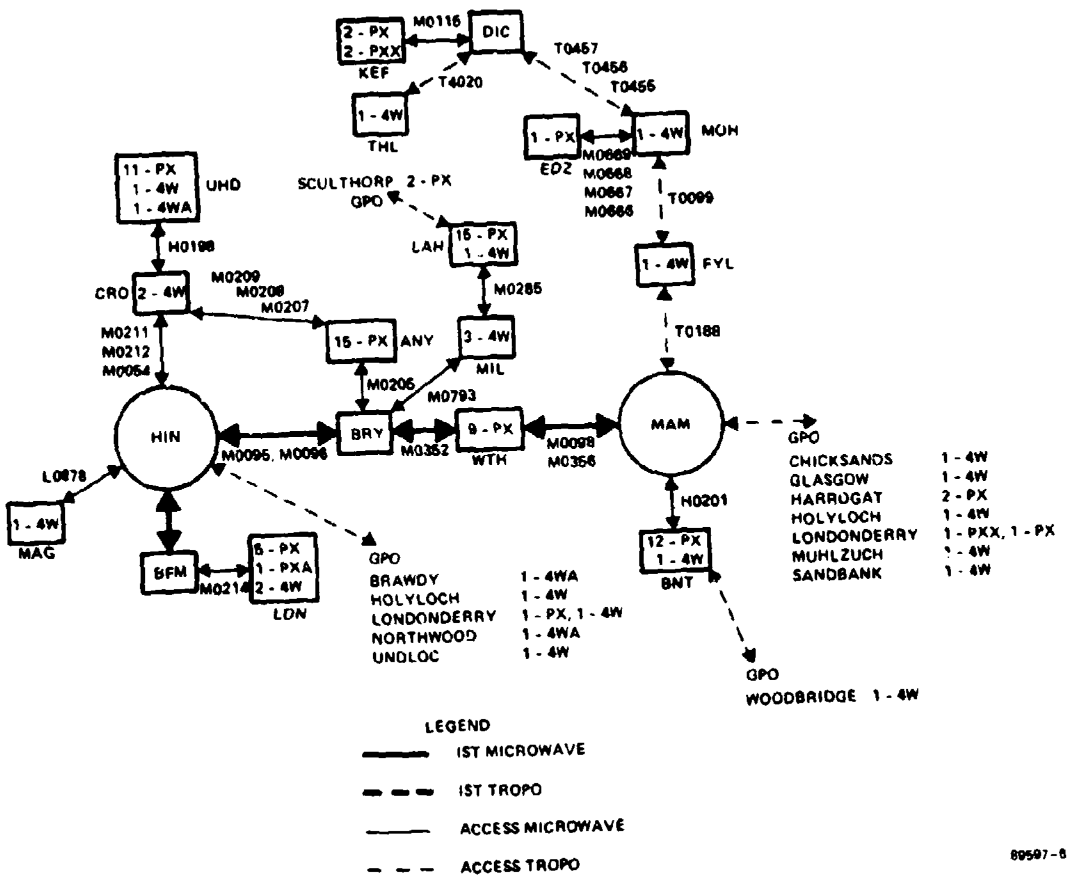


Figure A-2. Access Network for MAM

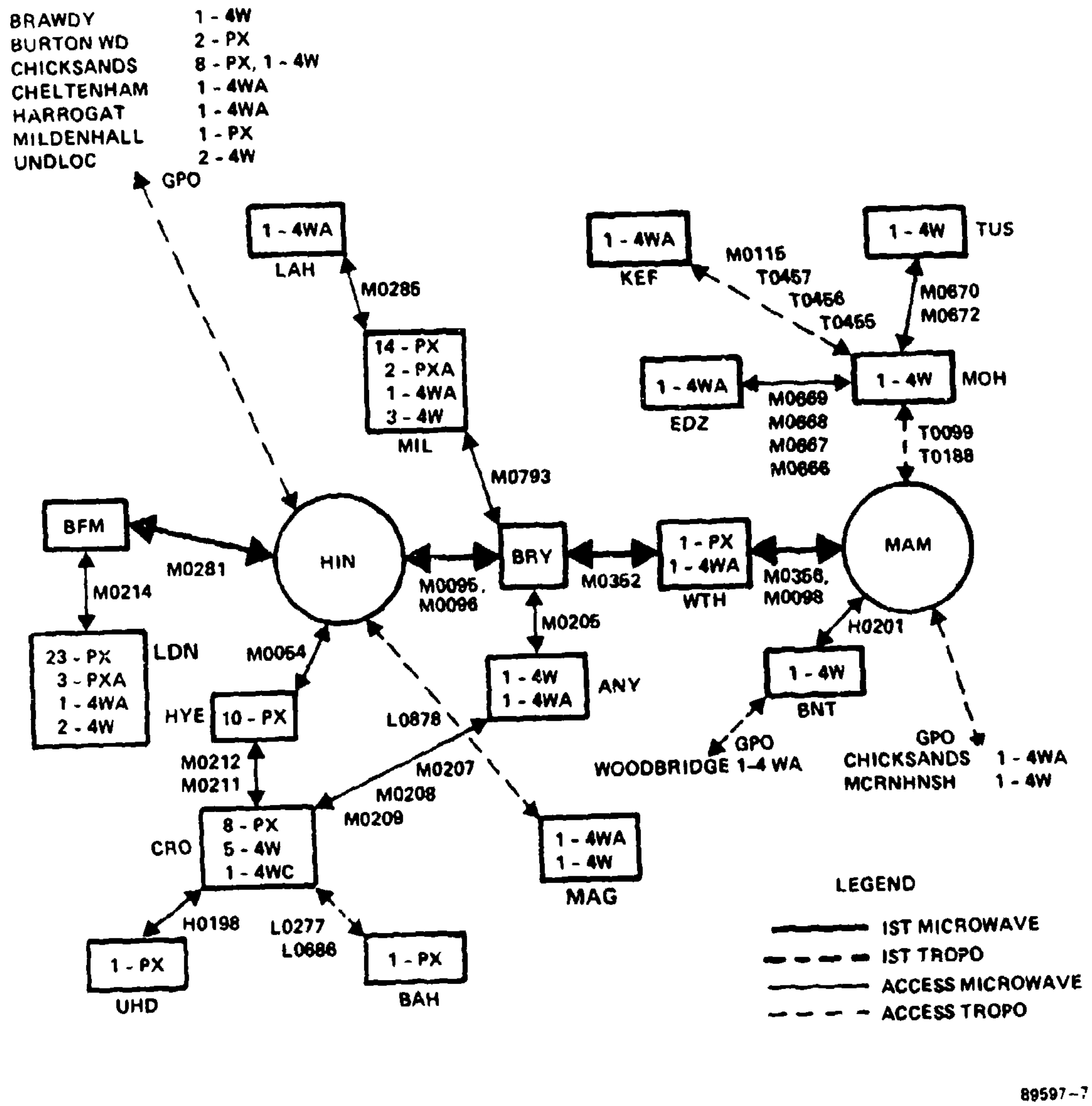


Figure A-3. Access Network for HIN

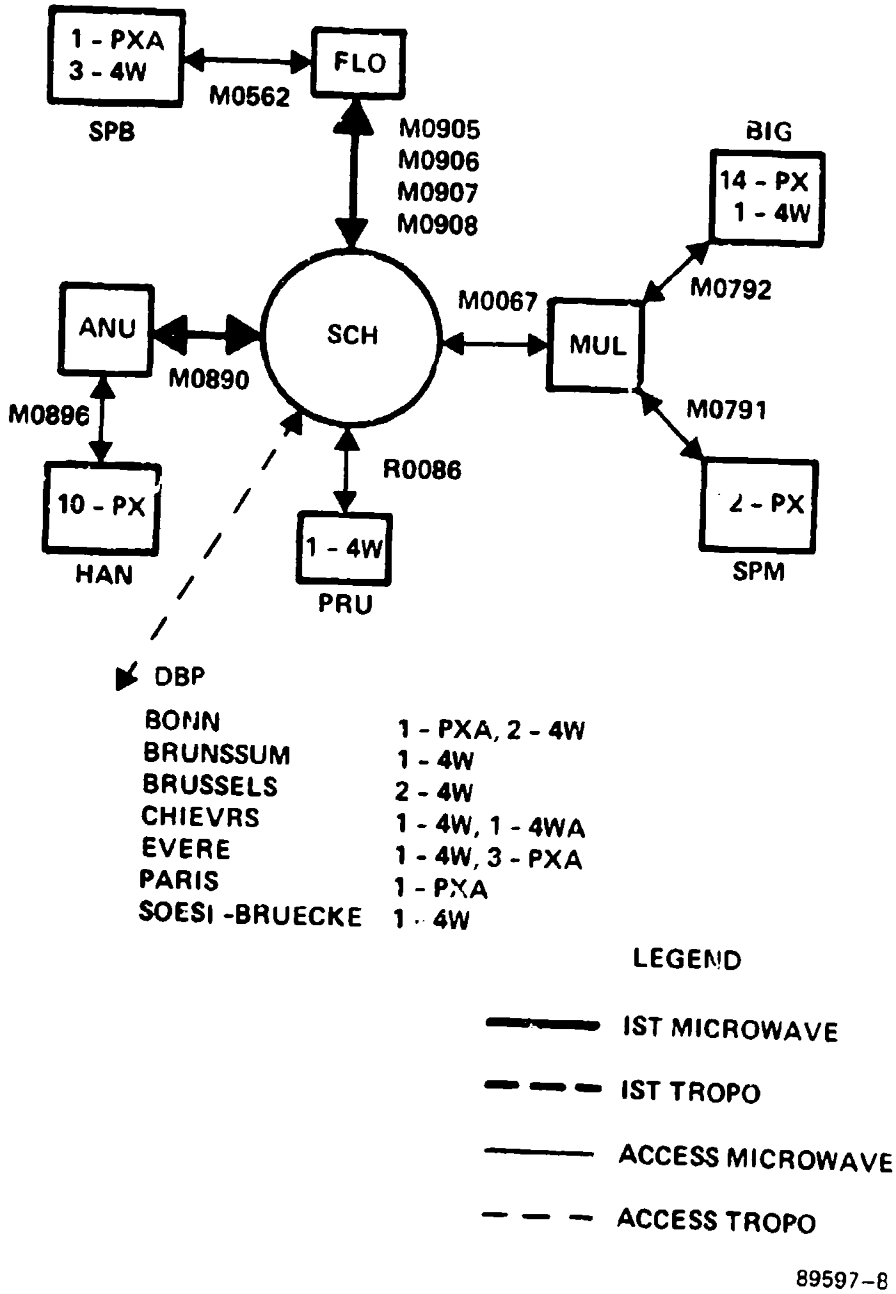


Figure A-4. Access Network for Schoenfeld

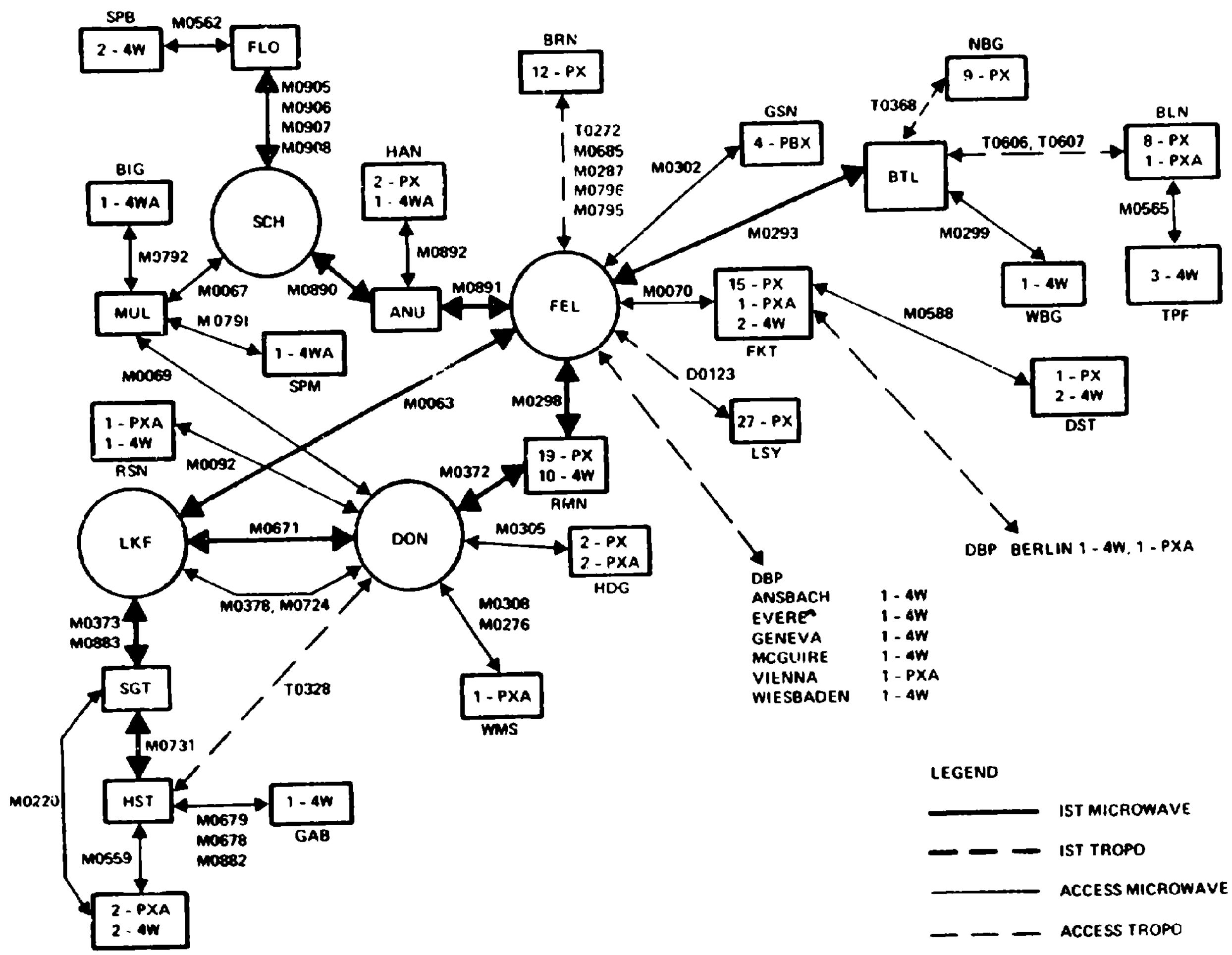


Figure A-5. Access Network for Feldberg

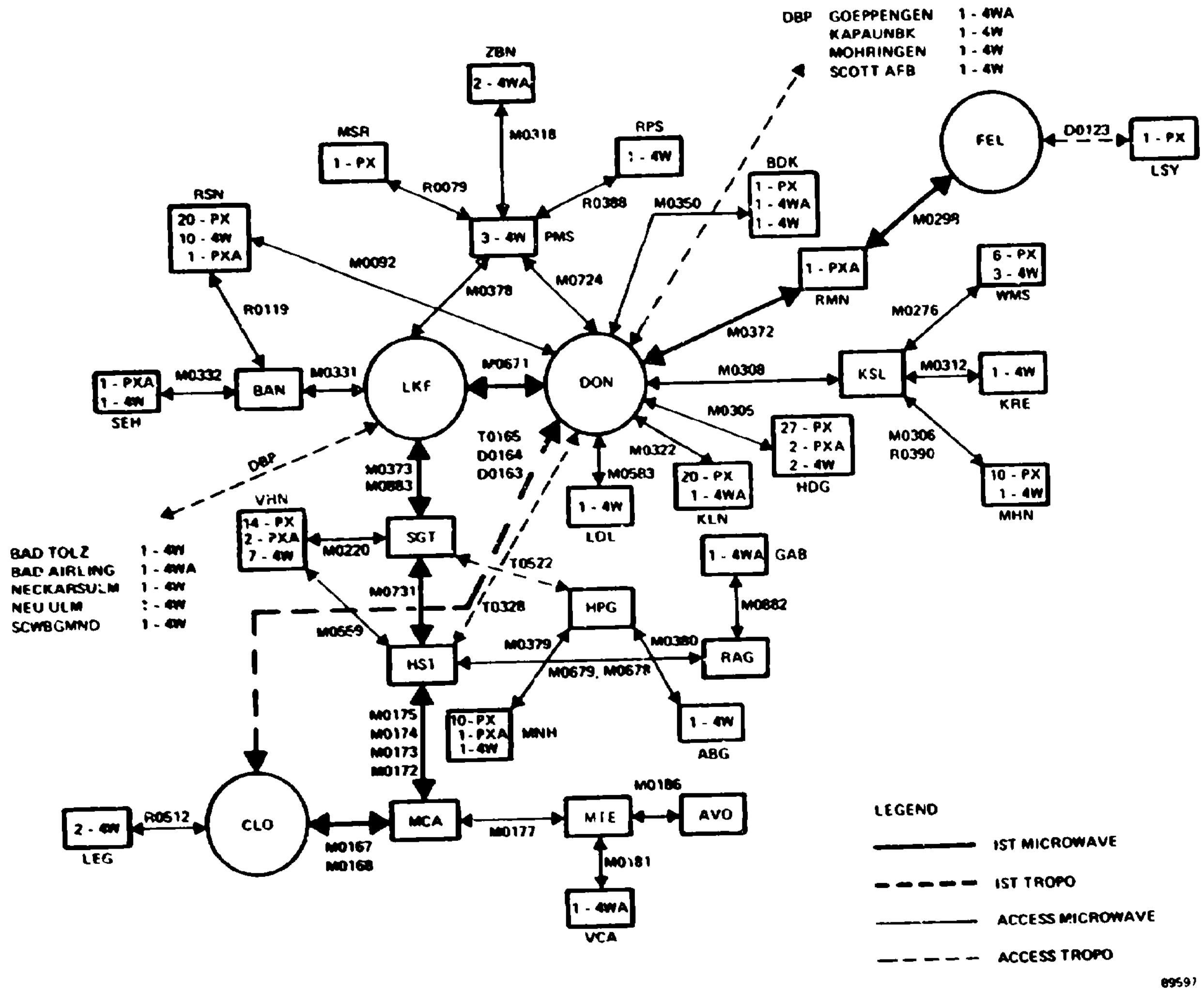


Figure A-6. Access Network for Donnersburg

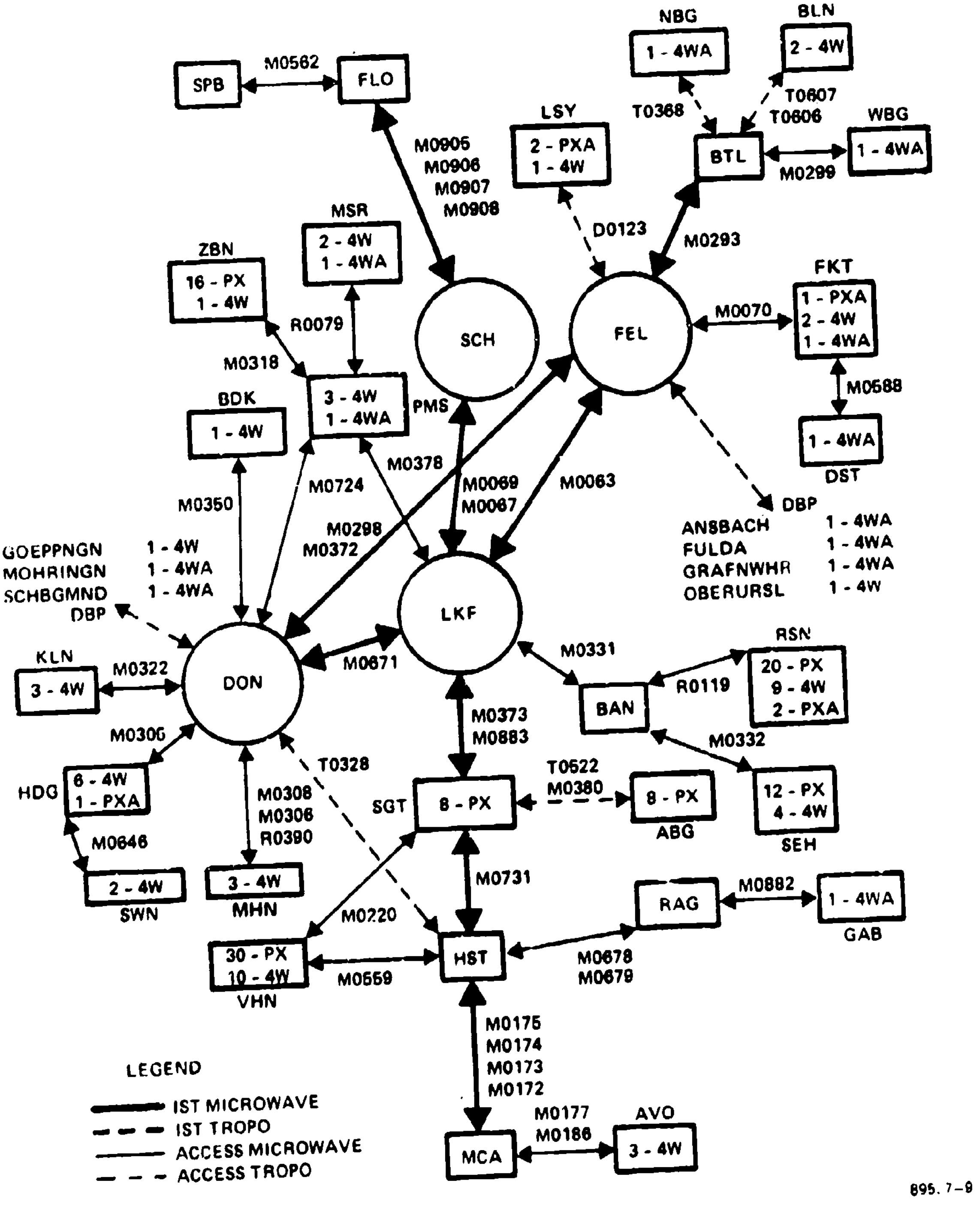


Figure A-7. Access Network for Langerkopf

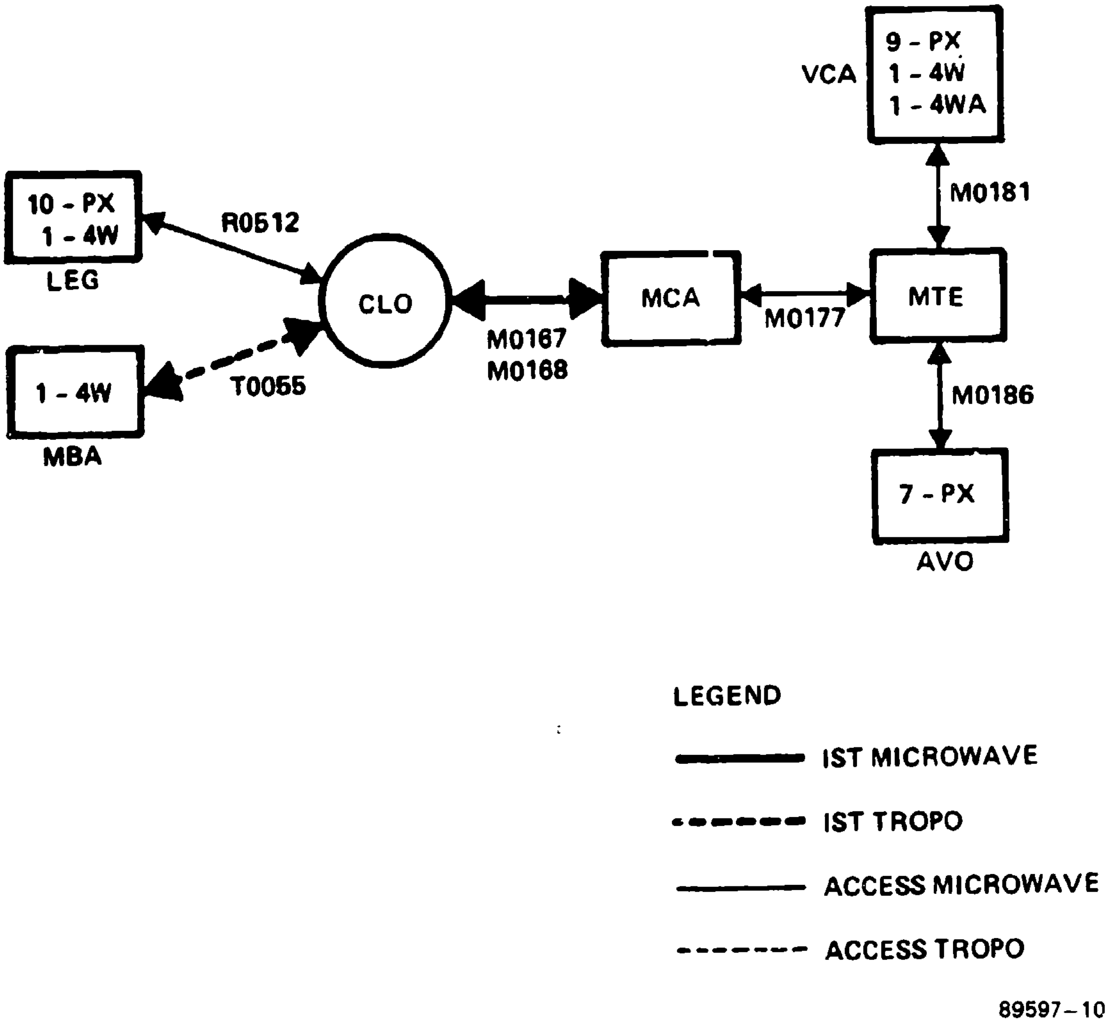


Figure A-8. Access Network for Coltano

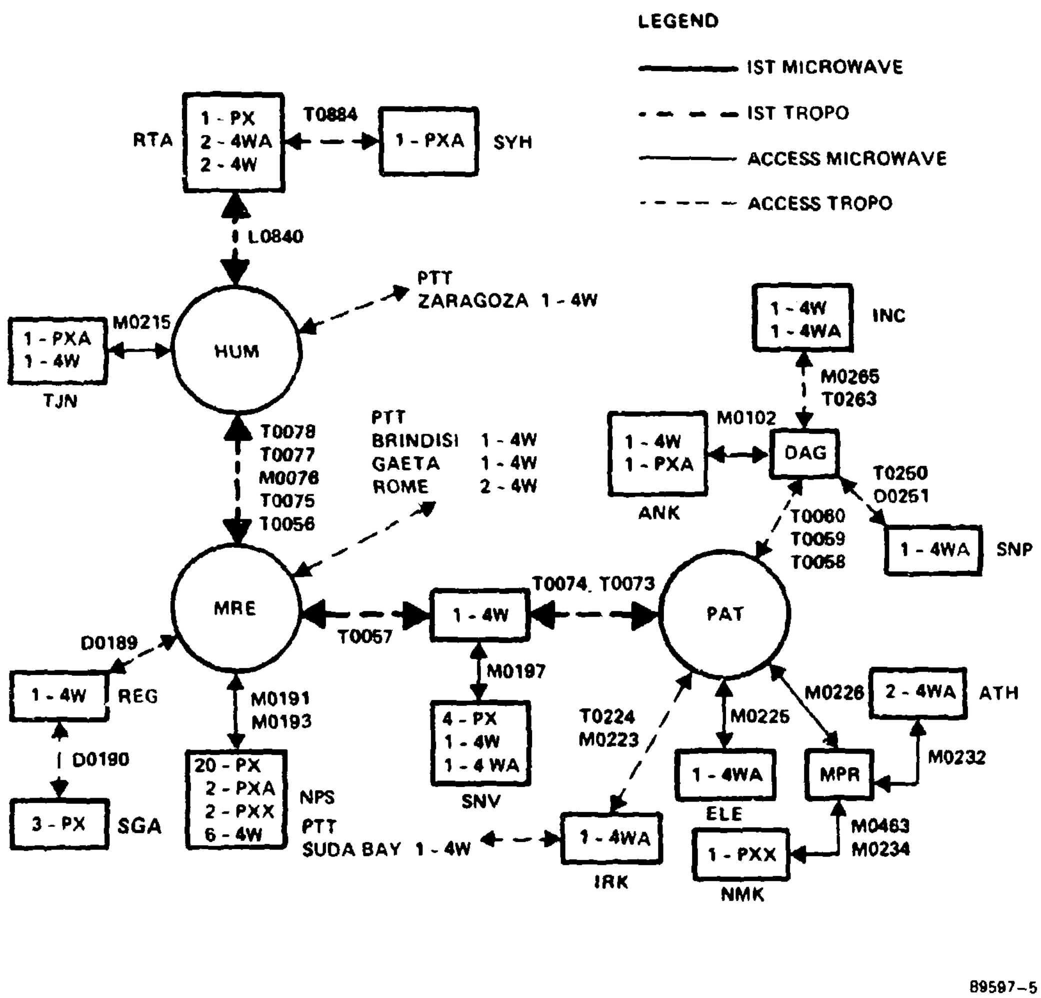


Figure A-9. Access Network for Mt. Vergine

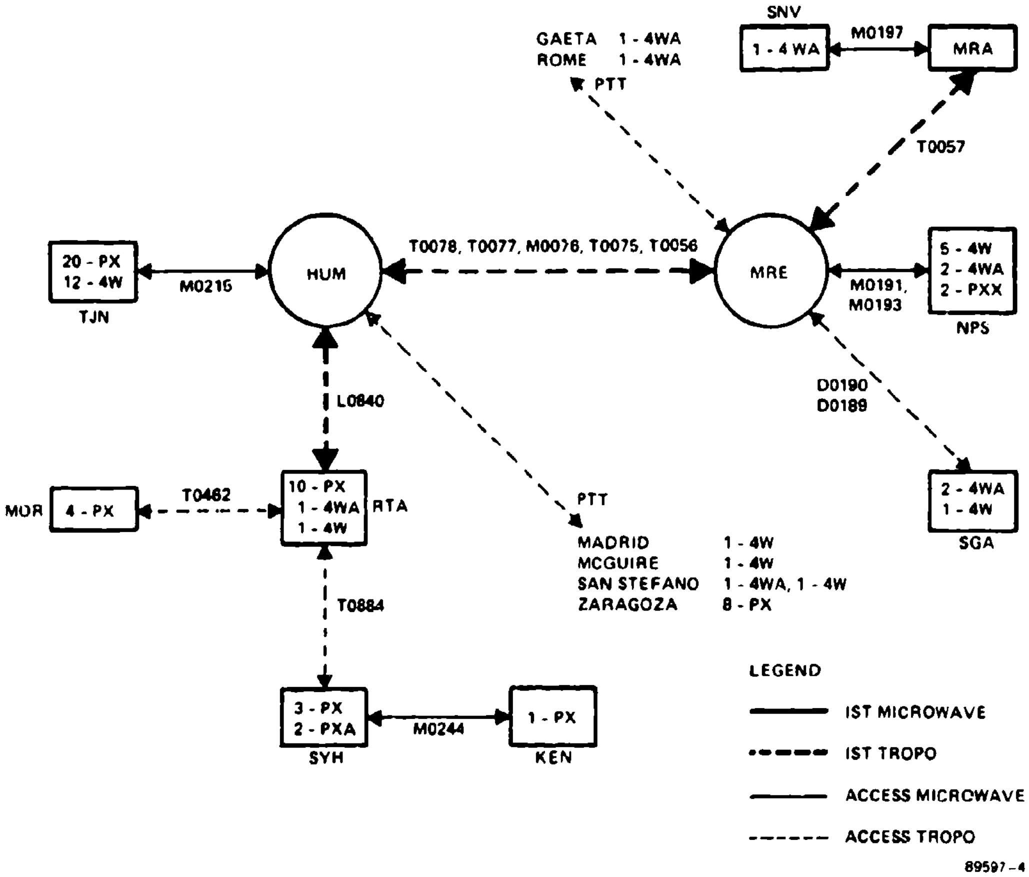


Figure A-10. Access Network for Humosa

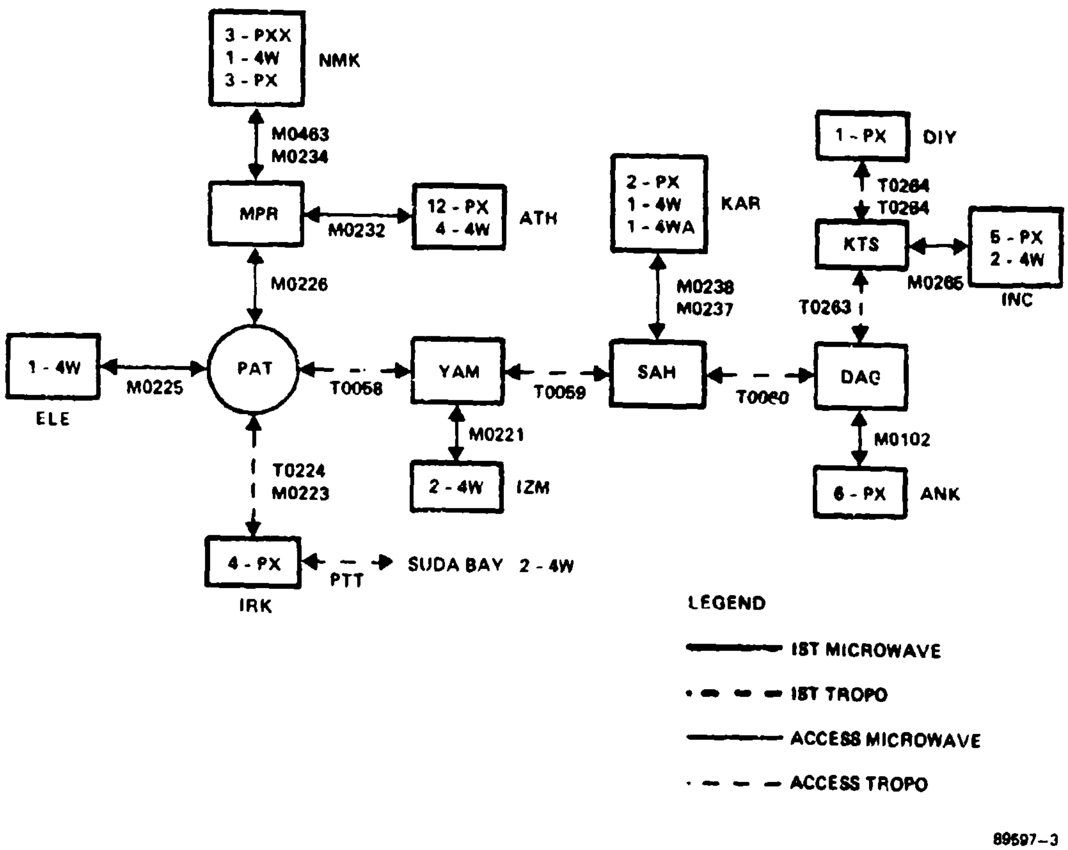


Figure A-11. Access Network for Mt. Pateras

Table A-1. Summary of Access Line Routings

Types of Routing

	M	T	D	L	R	H	PTT	Total No.
CLO	2	1	0	0	1	0	0	4
DON	16	8	1	0	4	0	9	38
FEL	17	6	1	0	0	0	9	33
LKF	16	5	2	0	3	0	7	33
SCH	4	0	0	0	1	0	7	12
HIN	9	4	0	2	0	2	12	29
MAM	9	5	0	0	0	4	15	29
HUM	1	7	0	1	0	0	5	14
PAT	3	7	0	0	0	0	0	10
MRE	1	14	2	0	0	0	3	13
Totals	76	57	6	3	9	6	67	221

Table A-2 shows a breakdown of the types of service and the types of links connecting the individual circuits. In this table the circuits involving LOS and government landlines (M, H, and R) have been combined as have those requiring tropo, diffraction or Telpak service (T, D and L). The first column indicates the number of subscriber locations with one or more circuits of the variety shown. The second column lists the total number of circuits involved. Thus there are 62 PBX's served which are connected by 600 circuits to the AUTOVON switches. There are 91 locations that connect 226 four wire circuits which are not switched by a PBX. Many of the 91 locations are common with those that have PBX service or other types of service. The number of routes is greater than the number of locations since some locations are connected to a switch by more than one route or are connected to more than one AUTOVON switch. There are 122 different subscriber locations connecting 928 circuits to AUTOVON switches.

There are a total of 77 different microwave LOS links, 22 different tropo links, four diffraction links, five government land line links, three Telpak links and two VHF or VHF-LOS links involved in the access network exclusive of links serving the IST network.

A.3 The Pacific Network

Figure A-12 shows the Pacific IST network connections. As can be seen most of the segments are connected by either DSCS satellites, Intelsat satellite service or undersea cables. The exceptions are two segments from the Philippines to Okinawa and from Okinawa to Japan. These links involve combinations of tropo, microwave, diffraction and undersea cable links.

Data on the access lines in the Pacific was not available in sufficient detail to make the type of analysis presented for the European network. The access lines tested were to secure voice manual switchboards (SECORDS) in the Pacific area. There are 18 different such switchboards in the Pacific.

Table A-2. Summary of Access Line Circuits

	No. of Locations	No. of Circuits	Types of Routing: M + R + H	T + D + L	PTT	No. of Routes
PX	62	600	42	24	8	74
4 WA	56	60	21	20	18	59
PXA	26	42	18	11	5	34
4 W	91	226	57	29	39	125
Totals	122	928	91	63	67	221
			41%	29%	30%	

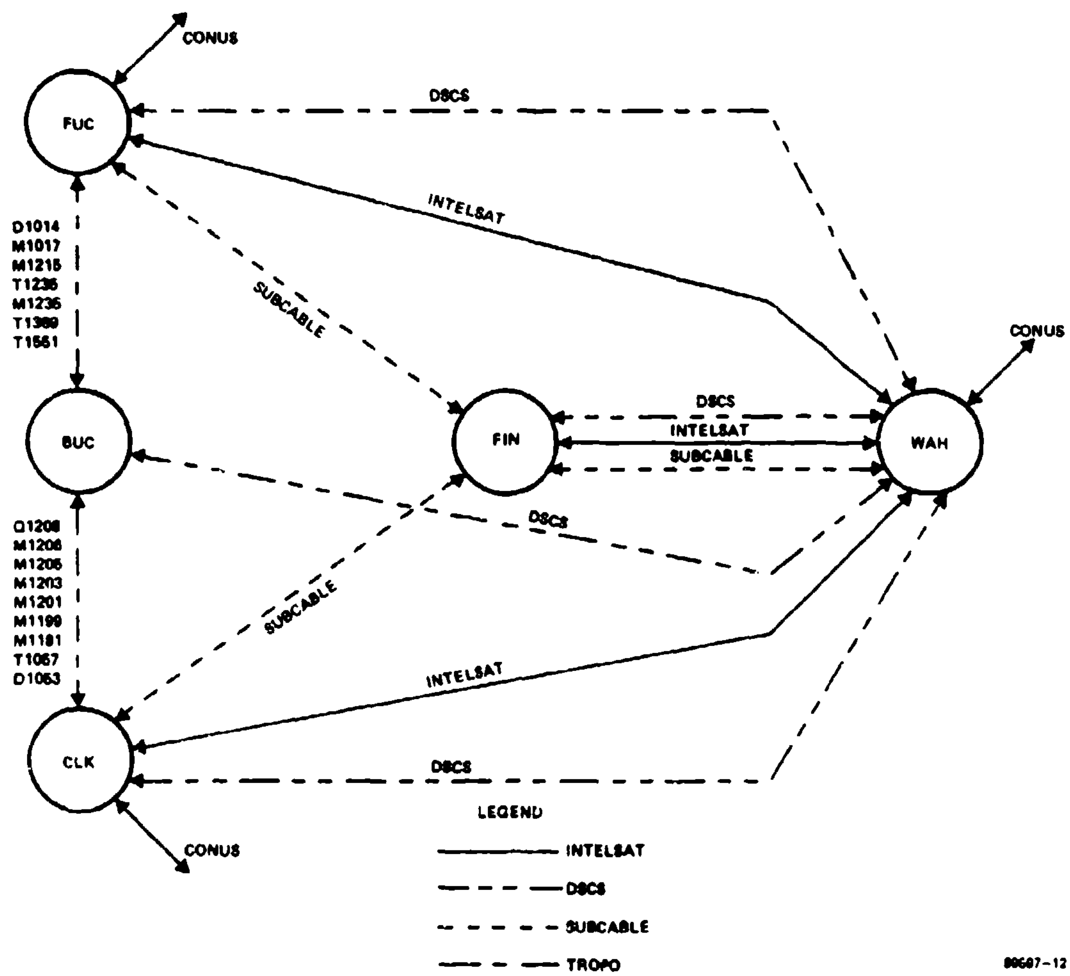


Figure A-12. Pacific IST Network

APPENDIX B

TEST SCHEDULE

Date		Location: Receiver/Transmitter	Location: Transmitter
November	1	Travel	Travel
	2	Travel	Travel
	3	Coltano, Italy	Coltano, Italy
	4		Coltano, Italy
	5		Travel
	6		Hillingdon, England
	7		
	8		
	9		
	10		
	11		
	12	Travel	
	13	Feldberg, Germany	
	14		
	15		
	16		
	17		
	18		
	19		
	20		
	21		
	22	Travel	Travel
	23	Hillingon, England	Coltano, Italy

APPENDIX B

TEST SCHEDULE (Continued)

Date		Location Receiver/Transmitter	Transmitter
November	24	Hillingdon, England	Coltano, Italy
	25		
	26		
	27		
	28		
	29	Christchurch, England	Ft. Detriech, MD
	30	Hillingdon, England	
December	1		
	2		
	3		Travel
	4	Travel	
	9	Travel	Travel
	10	Pearl Harbor, Hawaii	Stockton, CA
	11		
	12		
	13		
	14		
	15		
	16		
	17		
	18		
	19		
	20		
	21	Travel	Travel

APPENDIX C

TABLES OF DATA

Since the interpretation of data collected in a test program is always influenced by the use for which the interpretation is intended, it was felt necessary to include all of the raw data that was gathered during the tests. These are presented in this section in ten tables. Since the quantity of information gathered on each test was quite large, it was found necessary to divide the horizontal column and present them on two sheets. The first sheet contains the information associated with modem performance; and the second sheet contains all of the line test data and other pertinent information. When the number of entries in a table is too large to fit on one page, all of the pages associated with the first sheets (Sheet 1) of the table are first given, followed by all of the pages associated with the second sheets (Sheet 2) of the table. The second sheet entries are indexed by title so that the two sheets can be easily correlated.

Before presenting the tables the following glossary is given which identifies the meaning of the data in the columns. The glossary for Table C-1 is given first, followed by a glossary of the columns in subsequent tables having headings which differ from those in Table C-1.

GLOSSARY FOR TABLE C-1

1. Table No. - Numbers indicating table and location within the table.

2. Call No. - Numbers of the calls and data sheets in chronological order. The photographs in Appendix D are keyed to call numbers. A table converting call numbers to table numbers is given in Appendix D.

3. Locations - The two locations between which the call was placed. In the case of looped calls the modem location is given first and the location of the loop is

given second. In the case of one-way calls the transmitter location is given first, followed by the modem location.

4. Date - The month and day of the call. The year of all calls was 1976 except for those conducted in January of 1977.

5. Time - The time of day the call was established.

6. BER (A) 16-110 - The 16 kb error rate (including anomalous readings**) for the modem in the standard mode (110).

7. BER 8-110 - The 8 kb error rate (including anomalous readings**) for the modem in the standard mode (110).

8. BTP - Block throughput. The percent of 1-second (8000 bit) intervals which were error free.

9. M - The number of microwave LOS links transited by the call.*

10. T - The number of tropo links transited by the call.*

11. D - The number of diffraction links transited by the call.*

12. L - The number of commercial Telpak land links transited by the call.*

13. LC - The number of commercial undersea cable links transmitted by the call.*

14. DIST - The total distance traveled by the signal in statute miles.*

15. BER (B) 16-110 - The 16 kb error rate (excluding anomalous readings**) for the modem in the standard mode (110).

*In the case of loop around calls each link has been transmitted twice. This fact has been included in the numbers of links and distance.

**A discussion of the meaning of anomalous readings is presented on Page 11.

16. BER 16-130 - The 16 kb error rate in mode (130).

17. BER 16-111 - The 16 kb error rate in mode (111).

18. BER 16-C - The 16 kb error rate in mode (C).

19. Sync tries-hits - The total number of sync tries in a call in the normal sync mode followed by the number of successful synchronizations and equalization processes.

20. S/N - The equalizer signal-to-noise ratio in dB. This is the ratio of the equalizer error signal at the beginning of the training sequence (weights zeroes) to the equalizer error signal after training.

21. Table No. - Repeat of Column 1 to help index results.

22. Table No. - Same as Columns 1 and 21

23. Call No. - Same as Column 2.

24. Location (abbreviation) - An abbreviated version of the call locations given in Column 3.

25. Line Loss (Data) - The ratio in dB of the transmit signal to the receive signal when data is transmitted.

26. Line Loss - (1 kHz) - The ratio in dB of the transmit signal to the receive signal when a 1 kHz tone is transmitted.

27. S/N (Data) - The ratio in dB of the received line signal when data is transmitted to the received noise when a quiet line exists. Both signals are passed through a C-message weighted filter.

28. S/N (1 kHz) - The ratio in dB of the received signal when 1 kHz is transmitted to the received line signal when 1 kHz is notched out at the receiver. A C-message weighted filter is used.

29. PJ° - Peak-to-peak phase jitter in degrees.

30. HD 2nd - Second harmonic distortions in dB below the transmitted signal level.

31. HD 3rd - Third harmonic distortion in dB below the transmitted signal level.

32. HD Percent - Total harmonic distortion in percent of the transmitted signal level. (The square root of the sum of the squares of the second and third harmonic distortion values.)

33. GH +3 - Number of 3 dB gain hits in 5 minutes.

34. PH 20 - Number of 20 phase hits in 5 minutes.

35. 59 - Number of impulses exceeding 59 dBRNO in 5 minutes.

36. 63 - Number of impulses exceeding 63 dBRNO in 5 minutes.

37. 67 - Number of impulses exceeding 67 dBRNO in 5 minutes.

38. DO - Number of dropouts in 5 minutes.

39. Types of pictures - This specifies the type of pictures included in Appendix D for this call. The letter A indicates an amplitude-delay response picture is included. The letter B indicates a phase jitter picture. The letter C indicates an envelope picture, and D indicates a picture of the equalizer weights. Combination of letters indicate combinations of pictures are present.

40. Location of Recording - This provides the tape number and location on the tape of the recording made on this call.*

41. Type of Recording - This indicates the type of recording that was made. The first letter indicates:

    A - A 16 kb recording of test sentence from an IEEE tape

    B - A 16 kb recording of test sentences read by operator

*These tapes have been delivered to RADC as a part of the contract. Requests concerning these tapes should be addressed to RADC/DCLD.

C - No test sentences but some brief recording

D - An 8 kb recording of test sentences from an IEEE tape

E - An 8 kb recording of test sentence read by operator

The number following the letter indicates which set of test sentences was played or read. Appendix E contains the test sentence sets and their numbers.

42. Routing - This gives the last four digits of the CCSD designators of circuits involved in the routing. The first four digits of the CCSD designators have been omitted since they are the same for AUTOVON circuits in a given area. In a few instances CCSD designators were not identified, but group and channel numbers were included in their place.

Following each CCSD number is an indication as to whether the circuit is listed as V1, V2, or S3 conditioned.

43. Line Characteristics - This column indicates the highest line condition that the amplitude and delay characteristics of the composite circuits of the call meet, based on the picture of Appendix D.

44. Comments - These are comment numbers which are keyed to the table of comments in Table C-11 following the data tables.

45. Table No. - Same as Columns 1, 21 and 22.

Table C-2

13 R - The number of government land-line links transited by the call

14 DIG - The number of digital links transited by the call

Table C-5

9 NATO 1 - The number of satellite links through the NATO satellite with terminals located at Norfolk, Virginia and Oakhanger, England.

10 NATO 2 - The number of satellite links through the NATO satellite with terminals located at Lakehurst, New Jersey and Donnersburg, Germany.

11 INTELSAT - The number of satellite links through an INTELSAT satellite with terminals located at Andover, Maine and Goonhillydown, England.

12 TAT-I - The number of undersea cable links through the TAT-I cable with terminals located at Sydney Mines, Nova Scotia and Oban, Scotland.

13 TAT-III - The number of undersea cable links through the TAT-III cable with terminals located at Tuckerton, New Jersey and Widemouth, England.

14 TAT-IV - The number of undersea cable links through the TAT-IV cable with terminals located at Tuckerton, New Jersey and St. Hilairede Riez, France.

15 TAT-V - The number of undersea cable links through the TAT-V cable with terminals located at Greenhill, Rhode Island and Conil, Spain.

Table C-6

9 DSCS - The number of satellite links through a DSCS satellite with terminals located at Camp Roberts, California and Wahiawa, Hawaii.

10 INTELSAT I - The number of satellite links through an INTELSAT satellite with terminals located at San Luis Obispo, California and Wahiawa, Hawaii.

Table C-6 (Continued)

11 INTELSAT II - The number of satellite links through an INTELSAT satellite with terminals located at Lodi, California and Wahiawa, Hawaii.

12 HAWAII I - The number of undersea cable links through the HAWAII I cable with terminals located at San Luis Obispo, California and Makaha, Hawaii.

13 HAWAII II - The number of undersea cable links through the HAWAII II cable with terminals located at Pt. Arena, California and Hanaumby, Hawaii.

14 HAWAII III - The number of undersea cable links through the HAWAII III cable with terminals located at San Luis Obispo, California and Makaha, Hawaii.

Table C-7

9 COMSAT - The number of satellite links through an INTELSAT satellite transited by call.

10 DSCS - The number of satellite links through a DSCS satellite transited by call

11 Cable - The number of undersea cable links transited by call.

12 Tropo - The number of tropo links transited by call.

Table C-10

9 Type of Call - The special characteristic of the call.

Table C-1. European IST Loops (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	LC	Dist	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
						PRIMARY ROUTINGS														
1-1	10	Coltano, Italy - Hillingdon, Eng.	11/4	1454	3.08E-2	6.12E-5	68	32	8	2	2	0	3576	3.08E-2	3.25E-2	3.15E-2	2.79E-2	5-5	18	1-1
1-2	55	Coltano, Italy - Hillingdon, Eng.	11/9	2223	2.58E-3	3.13E-4	94	32	8	2	2	0	3576	2.58E-3	4.05E-3	2.85E-3	3.52E-3	4-4	22	1-2
1-3	58	Coltano, Italy - Hillingdon, Eng.	11/9	2336	8.49E-3	4.77E-4	97	32	8	2	2	0	3576	8.49E-3	8.99E-3	6.84E-3	9.00E-3	4-4	20	1-3
1-4	41	Coltano, Italy - Hillingdon, Eng.	11/8	1615	5.37E-2	2.13E-3	84	2	8	0	6	2	4238	5.37E-2	6.19E-2	8.57E-2	7.41E-2	4-4	18	1-4
1-5	47	Coltano, Italy - Hillingdon, Eng.	11/9	1107	1.32E-2	1.00E-5	97	32	8	2	2	0	3576	1.32E-2	7.50E-3	1.15E-2	8.20E-3	4-4	20	1-5
1-6	13	Coltano, Italy - Feldberg, Germ.	11/14	1705	3.40E-4	0	100	20	0	0	0	0	1080	3.40E-4	6.24E-4	-	-	3-3	25	1-6
1-7	2	Coltano, Italy - Humosa, Spain	11/3	1545	1.85E-2	4.50E-5	95	2	8	0	2	0	2374	1.85E-2	8.69E-3	2.11E-2	1.59E-2	7-7	21	1-7
1-8	28	Coltano, Italy - Humosa, Spain	11/8	0815	2.55E-3	7.87E-5	97	2	8	0	2	0	2374	2.55E-3	1.88E-3	3.92E-3	1.90E-3	4-4	25	1-8
1-9	54	Coltano, Italy - Humosa, Spain	11/9	2157	1.62E-3	8.87E-5	97	2	8	0	2	0	2374	1.62E-3	1.67E-3	1.66E-3	4.54E-4	4-4	24	1-9
1-10	57	Coltano, Italy - Humosa, Spain	11/9	2315	1.46E-4	0	100	2	8	0	2	0	2374	1.46E-4	3.67E-4	4.61E-4	2.76E-4	4-4	25	1-10
1-11	4	Coltano, Italy - Mt. Poteras, Greece	11/4	0920	1.91E-4	2.87E-5	99	2	6	0	2	0	1612	1.91E-4	1.38E-4	1.38E-1	3.14E-4	4-4	25	1-11
1-12	27	Coltano, Italy - Mt. Poteras, Greece	11/5	1620	1.24E-3	0	100	2	6	0	2	0	1612	1.24E-3	1.52E-3	2.71E-3	8.06E-4	4-4	24	1-12
1-13	56	Coltano, Italy - Mt. Poteras, Greece	11/9	2250	4.02E-4	0	100	2	6	0	2	0	1612	4.02E-4	8.45E-4	1.03E-2	7.68E-4	4-4	24	1-13
1-14	59	Coltano, Italy - Mt. Poteras, Greece	11/9	2357	3.58E-4	5.00E-6	99	2	6	0	2	0	1612	3.58E-4	3.38E-4	2.00E-4	1.14E-4	4-4	23	1-14
1-15	62	Coltano, Italy - Mt. Poteras, Greece	11/10	1507	1.02E-4	6.37E-5	95	2	6	0	2	0	1612	1.02E-4	2.74E-4	2.79E-4	2.71E-4	4-4	25	1-15
1-16	6	Coltano, Italy - Mt. Vergine, Italy	11/4	1005	3.31E-4	1.50E-5	100	0	0	0	2	0	580	3.31E-4	6.25E-5	-	-	4-4	28	1-16
1-17	7	Coltano, Italy - Schoenfeld, Germ.	11/4	1027	1.60E-4	0	100	4	2	4	0	0	1252	1.60E-4	1.40E-4	8.75E-5	6.62E-5	4-4	26	1-17
1-18	9	Coltano, Italy - Martlesham Heath, Eng.	11/3	1216	1.33E-3	5.25E-5	100	6	6	4	0	0	1844	1.33E-3	1.39E-3	1.83E-3	1.14E-3	4-4	24	1-18
1-19	12	Coltano, Italy - Donnersburg, Germ.	11/4	1556	6.00E-5	1.00E-5	100	0	2	4	0	0	970	6.00E-5	1.87E-5	1.60E-5	7.50E-5	4-4	29	1-19
1-20	14	Coltano, Italy - Langerkopf, Germ.	11/4	1723	3.40E-4	0	100	18	0	0	0	0	1004	3.40E-4	6.24E-4	-	-	4-4	25	1-20
1-21	69	Feldberg, Germ.- Hillingdon, Eng.	11/15	0933	1.75E-5	2.00E-5	100	26	0	0	0	0	842	1.75E-5	7.50E-6	0	1.25E-5	4-4	28	1-21
1-22	77	Feldberg, Germ.- Hillingdon, Eng.	11/15	1518	0	0	100	26	0	0	0	0	842	0	0	0	0	4-4	30	1-22
1-23	136	Feldberg, Germ.- Hillingdon, Eng.	11/19	1350	3.75E-6	0	100	26	0	0	0	0	842	3.75E-6	0	0	0	4-4	28	1-23
1-24	99	Feldberg, Germ.- Coltano, Italy	11/17	1110	2.45E-3	8.87E-5	99	28	0	0	0	0	1682	2.45E-3	1.99E-3	3.16E-3	1.89E-3	3-3	21	1-24
1-25	96	Feldberg, Germ.- Humosa, Spain	11/17	0956	3.31E-2	5.14E-4	92	22	12	0	0	0	3996	3.31E-2	3.66E-2	3.14E-2	3.73E-2	4-4	19	1-25
1-26	95	Feldberg, Germ.- Mt. Poteras, Greece	11/17	0925	1.16E-2	1.20E-4	89	20	10	0	0	0	3234	1.16E-2	2.42E-2	1.24E-2	1.12E-2	4-4	22	1-26

Table C-1. European IST Loops (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	LC	Dist	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
		PRIMARY ROUTINGS (CONTINUED)																		
1-27	97	Feldberg, Germ. - Mt. Vergine, Italy	11/17	1027	7.35E-2	5.11E-4	94	20	4	0	0	0	2202	7.35E-2	5.37E-2	1.98E-2	6.20E-3	4-4	22	1-27
1-28	102	Feldberg, Germ. - Schoenfeld, Germ.	11/17	1305	0	0	100	4	0	0	0	0	192	0	0	0	0	4-4	28	1-28
1-29	103	Feldberg, Germ. - Martlesham Heath, Eng.	11/17	1324	1.37E-4	4.50E-3	88	2	4	2	0	0	688	1.37E-4	5.45E-4	1.87E-4	5.25E-5	4-4	24	1-29
1-30	101	Feldberg, Germ. - Donnersburg, Germ.	11/17	1244	0	0	100	4	0	0	0	0	88	0	0	3.75E-6	0	4-4	30	1-30
1-31	100	Feldberg, Germ. - Langerkopf, Germ.	11/17	1130	0	0	100	2	0	0	0	0	140	0	0	0	0	5-4	29	1-31
1-32	152	Hillingdon, Eng. - Coltano, Italy	11/24	0950	6.23E-2	9.91E-4	99	32	8	2	2	0	3576	6.23E-2	7.89E-2	2.10E-1	6.01E-2	4-4	15	1-32
1-33	154	Hillingdon, Eng. - Coltano, Italy	11/24	1135	1.25E-2	5.64E-4	81	2	8	0	6	2	4238	1.25E-2	1.54E-2	1.10E-2	1.19E-2	4-4	20	1-33
1-34	160	Hillingdon, Eng. - Feldberg, Germ.	11/25	0945	0	0	100	26	0	0	0	0	842	0	0	6.25E-6	0	4-4	27	1-34
1-35	161	Hillingdon, Eng. - Humosa, Spain	11/25	1002	0	0	100	0	0	0	4	2	1864	0	9.12E-5	7.60E-6	0	4-4	27	1-35
1-36	181	Hillingdon, Eng. - Humosa, Spain	11/26	1540	3.56E-4	7.50E-6	99	0	0	0	6	2	3264	3.56E-4	1.89E-3	4.55E-4	3.60E-4	4-4	20	1-36
1-37	166	Hillingdon, Eng. - Mt. Pateras, Greece	11/25	1508	2.67E-3	-	-	2	14	0	4	2	4690	2.67E-3	-	-	-	1-1	22	1-37
1-38	167	Hillingdon, Eng. - Mt. Pateras, Greece	11/25	1510	2.44E-3	1.00E-5	98	2	14	0	4	2	4690	2.44E-3	3.97E-3	1.45E-3	1.66E-3	4-4	22	1-38
1-39	169	Hillingdon, Eng. - Mt. Vergine, Italy	11/25	1555	7.83E-3	3.25E-5	99	32	8	2	0	0	3094	7.83E-3	8.77E-3	1.11E-2	8.50E-3	4-4	18	1-39
1-40	164	Hillingdon, Eng. - Schoenfeld, Germ.	11/25	1152	2.50E-6	0	100	26	0	0	0	0	840	2.50E-6	1.00E-4	1.12E-5	3.75E-6	4-4	28	1-40
1-41	159	Hillingdon, Eng. - Martlesham Heath, Eng.	11/25	0921	1.02E-4	1.50E-5	99	10	0	0	0	0	201	0	0	1.25E-6	0	4-4	29	1-41
1-42	171	Hillingdon, Eng. - Donnersburg, Germ.	11/25	1648	0	0	100	30	0	0	0	0	930	0	0	0	0	4-4	26	1-42
1-43	170	Hillingdon, Eng. - Langerkopf, Germ.	11/25	1620	0	0	100	26	0	0	0	0	840	0	2.50E-6	0	0	4-4	29	1-43
		SECONDARY ROUTINGS																		
1-44	39	Coltano, Italy - Hillingdon, Eng.	11/8	1515	9.91E-4	0	100	46	0	0	0	0	1922	9.91E-4	1.06E-3	9.24E-4	7.34E-4	6-5	20	1-44
1-45	51	Coltano, Italy - Hillingdon, Eng.	11/9	1515	8.07E-4	1.89E-3	98	46	0	0	0	0	1922	8.07E-4	6.02E-4	1.30E-3	7.40E-4	4-4	22	1-45
1-46	53	Coltano, Italy - Hillingdon, Eng.	11/9	1624	8.47E-4	2.50E-6	99	46	0	0	0	0	1922	8.47E-4	2.31E-3	2.21E-3	6.74E-3	4-4	23	1-46
1-47	36	Coltano, Italy - Feldberg, Germ.	11/8	1117	4.55E-5	0	100	4	2	4	0	0	1058	4.55E-5	4.37E-5	6.37E-5	3.02E-5	5-4	28	1-47
1-48	22	Coltano, Italy - Humosa, Spain	11/5	1330	5.40E-2	6.16E-3	20	22	10	4	0	0	3870	5.40E-2	5.12E-2	4.74E-2	5.06E-2	4-4	17	1-48
1-49	23	Coltano, Italy - Humosa, Spain	11/5	1425	3.50E-2	4.37E-5	93	42	8	0	0	0	3950	3.50E-2	4.18E-2	4.11E-2	3.47E-2	4-4	17	1-49
1-50	24	Coltano, Italy - Humosa, Spain	11/5	1450	5.29E-2	5.37E-5	90	42	8	0	0	0	3950	5.29E-2	6.03E-2	6.35E-2	6.69E-2	4-4	17	1-50

Table C-1. European IST Loops (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	LC	Dist	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
		SECONDARY ROUTINGS (CONTINUED)																		
1-51	25	Coltano, Italy - Mt. Poteros, Greece	11/5	1528	2.66E-2	3.75E-5	85	0	14	8	0	0	3836	2.66E-2	4.12E-2	4.07E-2	4.56E-2	4-4	20	1-51
1-52	35	Coltano, Italy - Mt. Vergine, Italy	11/8	1058	4.75E-2	8.25E-5	80	40	4	0	0	0	3282	4.75E-2	4.71E-2	4.24E-2	6.62E-2	3-3	18	1-52
1-53	30	Coltano, Italy - Schoenfeld, Germ.	11/8	0913	7.36E-4	0	100	24	0	0	0	0	1272	7.36E-4	9.50E-4	1.13E-4	9.07E-4	4-4	23	1-53
1-54	29	Coltano, Italy - Martlesham Heath, Eng.	11/8	0848	2.33E-2	8.87E-5	91	22	4	2	0	0	1768	8.57E-3	8.01E-3	8.56E-3	8.75E-3	3-2	20	1-54
1-55	31	Coltano, Italy - Donnersburg, Germ.	11/8	0943	1.03E-3	0	100	24	0	0	0	0	1168	1.03E-3	9.98E-4	1.01E-3	8.85E-4	4-4	23	1-55
1-56	32	Coltano, Italy - Langerkopf, Germ.	11/8	1008	7.05E-4	-	-	22	0	0	0	0	1220	7.05E-4	1.70E-3	1.11E-3	-	2-2	23	1-56
1-57	33	Coltano, Italy - Langerkopf, Germ.	11/8	1010	9.59E-4	7.50E-6	96	22	0	0	0	0	1220	9.59E-4	7.27E-4	7.51E-4	1.50E-3	4-4	23	1-57
1-58	79	Feldberg, Germ.- Hillingdon, Eng.	11/15	1530	3.06E-4	-	100	12	4	2	0	0	892	3.06E-4	-	-	-	1-1	25	1-58
1-59	130	Feldberg, Germ.- Hillingdon, Eng.	11/19	1040	2.44E-3	7.28E-4	98	12	4	2	0	0	892	2.44E-3	2.97E-3	3.81E-3	3.01E-3	4-4	23	1-59
1-60	109	Feldberg, Germ.- Coltano, Italy	11/17	1522	4.25E-5	1.25E-4	99	4	2	4	0	0	1138	4.25E-5	2.12E-5	5.16E-5	2.11E-4	5-4	27	1-60
1-61	104	Feldberg, Germ.- Humosa, Spain	11/17	1340	1.17E-2	5.06E-3	96	-	-	-	-	-	-	1.17E-2	1.25E-2	1.14E-2	1.32E-2	4-4	20	1-61
1-62	105	Feldberg, Germ.- Mt. Poteros, Greece	11/17	1410	2.05E-2	-	-	4	12	4	0	0	2954	2.05E-2	2.27E-2	1.55E-2	9.19E-3	2-2	20	1-62
1-63	107	Feldberg, Germ.- Mt. Vergine, Italy	11/17	1441	2.20E-2	4.12E-5	93	0	6	4	0	0	1834	2.20E-2	2.12E-2	3.78E-2	2.17E-2	4-4	20	1-63
1-64	112	Feldberg, Germ.- Schoenfeld, Germ.	11/17	1630	3.49E-3	0	100	8	0	0	0	0	390	3.49E-3	5.45E-3	2.53E-3	7.65E-4	4-4	24	1-64
1-65	128	Feldberg, Germ.- Martlesham Heath, Eng.	11/19	0838	7.72E-4	1.50E-5	97	6	4	2	0	0	874	7.72E-4	9.34E-4	9.06E-4	4.33E-4	6-6	25	1-65
1-66	108	Feldberg, Germ.- Donnersburg, Germ.	11/17	1503	5.00E-6	0	100	4	0	0	0	0	186	5.00E-6	0	3.75E-6	0	6-4	29	1-66
1-67	113	Feldberg, Germ.- Langerkopf, Germ.	11/17	1658	0	0	100	6	0	0	0	0	134	0	7.50E-6	1.50E-5	7.50E-6	7-4	25	1-67
1-68	156	Hillingdon, Eng.- Coltano, Italy	11/24	1413	5.03E-3	2.50E-6	91	46	0	0	0	0	1922	5.03E-3	6.52E-3	6.26E-3	6.45E-3	4-4	19	1-68
1-69	178	Hillingdon, Eng.- Feldberg, Germ.	11/26	1410	1.79E-3	5.75E-5	91	12	4	2	0	0	892	1.79E-3	2.24E-3	2.13E-3	1.96E-3	3-3	20	1-69
1-70	152	Hillingdon, Eng.- Humosa, Spain	11/25	1028	8.11E-3	4.75E-5	90	50	8	0	0	0	3822	8.11E-3	1.05E-2	1.67E-2	1.03E-2	4-4	20	1-70
1-71	168	Hillingdon, Eng.- Mt. Poteros, Greece	11/25	1542	9.41E-2	-	-	-	-	-	-	-	3944	9.41E-2	-	-	-	1-1	18	1-71
1-72	180	Hillingdon, Eng.- Mt. Poteros, Greece	11/26	1455	2.30E-2	6.45E-4	76	20	10	0	0	0	2946	2.30E-2	1.83E-2	2.05E-2	2.04E-2	5-5	18	1-72
1-73	173	Hillingdon, Eng.- Mt. Vergine, Italy	11/26	1030	1.03E-2	5.00E-6	99	46	4	0	0	0	3044	1.03E-2	1.19E-2	1.23E-2	1.89E-2	4-4	20	1-73
1-74	175	Hillingdon, Eng.- Schoenfeld, Germ.	11/26	1135	1.25E-6	0	100	30	0	0	0	0	2394	1.25E-6	7.50E-6	5.00E-6	0	4-4	28	1-74
1-75	179	Hillingdon, Eng.- Donnersburg, Germ.	11/26	1435	1.09E-3	7.00E-5	89	16	4	2	0	0	1076	1.09E-3	1.20E-3	8.48E-4	9.53E-4	5-4	24	1-75
1-76	177	Hillingdon, Eng.- Langerkopf, Germ.	11/26	1155	1.30E-3	2.50E-6	99	28	0	0	0	0	984	3.16E-6	1.25E-5	4.69E-6	3.13E-6	4-4	25	1-76

Table C-1. European IST Loops (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	Bit	M	T	D	L	LC	Dist	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Trans-Hits	S/N	Table #
						TERNARY ROUTINGS														
1-77	106	Feldberg, Germ. - Humosa, Spain	11/17	1418	6.25E-5	3.01E-3	98	26	0	0	4	2	2706	6.25E-6	2.00E-5	3.12E-5	2.50E-6	4-4	28	1-77
1-78	172	Hillingdon, Eng. - Humosa, Spain	11/26	0952	2.45E-2	3.87E-5	98	48	12	0	0	0	4838	2.45E-2	2.18E-2	2.17E-2	2.06E-2	5-4	19	1-78
1-79	174	Hillingdon, Eng. - Donnersburg, Germ.	11/26	1050	2.88E-5	2.50E-6	99	30	0	0	0	0	930	2.88E-5	7.88E-5	4.00E-5	3.50E-5	4-4	27	1-79
1-80	176	Hillingdon, Eng. - Donnersburg, Germ.	11/26	1150	3.75E-6	-	-	30	0	0	0	0	930	8.75E-6	-	-	-	1-1	27	1-80
						NONENGINEERED ROUTINGS														
1-81	43	Coltano, Italy - Hillingdon, Eng.	11/8	1645	5.54E-4	9.12E-5	94	16	6	6	0	0	2048	5.54E-4	7.69E-4	7.39E-4	6.96E-4	5-5	23	1-81
1-82	45*	Coltano, Italy - Hillingdon, Eng.	11/9	1000	1.59E-2	0	100	2	8	0	6	2	4238	1.59E-2	1.92E-2	1.89E-2	2.33E-2	5-5	20	1-82
1-83	81	Feldberg, Germ. - Hillingdon, Eng.	11/15	1630	2.23E-2	7.37E-5	94	2	10	4	4	2	6156	2.23E-2	2.65E-2	2.41E-2	2.66E-2	8-4	22	1-83
1-84	134	Feldberg, Germ. - Hillingdon, Eng.	11/19	1245	1.99E-2	7.50E-6	87	-	-	-	-	-	-	1.99E-2	1.43E-2	3.82E-2	1.99E-2	3-3	17	1-84
1-85	132	Feldberg, Germ. - Hillingdon, Eng.	11/19	1215	1.18E-1	4.05E-3	62	52	12	2	0	0	5296	1.18E-1	7.32E-2	1.22E-1	8.08E-2	7-6	12	1-85

Table C-1. European IST Loops (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
													PRIMARY ROUTINGS										
1-1	10	CLO-HIN	-3	-3	28	26	12	45	46	.75	0	39	1732	641	89	2	A	1-1,156	A-6, D-7	CLO 9CVM V2 MRE 9AEB V2 HIN	V2		1-1
1-2	55	CLO-HIN	-1	-2	32	29	13	∞	40	1.00	0	7	1145	73	12	10	AB	2-1,057	A-10	CLO 9CVM V2 MRE 9AEB V2 HIN	V2		1-2
1-3	58	CLO-HIN	6	4	30	30	13	43	42	1.06	1	7	1075	54	9	8	AB	2-1,093	C	CLO 9CVM V2 MRE 9AEA V2 HIN	V2		1-3
1-4	41	CLO-HIN	3	1	30	32	10	40	39	1.50	2	28	475	177	56	5	AC	1-2,219	A-5	CLO 9CVR S3 MRE 9CHL S3 HUM 9CMM S3 HIN	V1		1-4
1-5	47	CLO-HIN	5	3	30	28	14	44	41	1.09	1	32	1579	203	0	0	AB	1-2,417	A-8	CLO 9DQF S3 MRE 9AEC V2 HIN	V2		1-5
1-6	13	CLO-FEL	2	1	33	32	8	50	47	.55	0	0	224	2	0	0	A	—	—	CLO 9CUX V2 FEL	V2		1-6
1-7	2	CLO-HUM	-1	-3	32.5	33	7	41	38	1.54	3	4	578	245	68	0	A	1-1,016	B-2	CLO 9DQD V2 MRE — — HUM	V2	1	1-7
1-8	28	CLO-HUM	-3	-3	36	36	5	39	37	1.80	0	1	271	125	42	0	A	1-2,021	A-1	CLO 9CVM V2 MRE 9CHU V2 HUM	V2		1-8
1-9	54	CLO-HUM	5	4	31.5	33	6	38	40	1.61	1	0	53	12	1	1	AC	1-2,036	A	CLO 9CVN V2 MRE 9CPG V2 HUM	V2		1-9
1-10	57	CLO-HUM	7	6	34.5	34	6	40	40	1.41	0	0	233	71	9	0	A	1-2,057	A	CLO 9DQD V2 MRE 9CPG V2 HUM	V2		1-10
1-11	4	CLO-PAT	-1	-4	39	37	4	40	39	1.50	0	0	146	47	6	0	A	1-1,051	A-4	CLO 9CVN V2 MRE 9CWY V2 PAT	V2		1-11
1-12	27	CLO-PAT	-1	-3	40	28	8	37	37	2.00	0	0	490	112	21	0	AB	1-2,001	A-1	CLO 9CVN V2 MRE 9DDA V2 PAT	V2		1-12
1-13	56	CLO-PAT	4	2	32	33	7	41	39	1.43	0	0	197	27	4	0	AD	2-1,078	C	CLO 9CVM V2 MRE 9CWX V2 PAT	V2		1-13
1-14	59	CLO-PAT	-3	-4	39.5	33	9	35	37	2.27	0	0	315	54	9	0	A	2-1,101	C	CLO 9CVM V2 MRE 9DDA V2 PAT	V2		1-14
1-15	62	CLO-PAT	1	0	37	30	10	39	36	1.94	0	0	302	113	16	0	AB	2-1,184	C	CLO 9CVM V2 MRE 9CXD S3 PAT	V2		1-15
1-16	6	CLO-MRE	2	1	40	39	4	49	46	.61	-	0	189	92	39	1	A	1-1,086	C	CLO 9CVR S3 MRE	V2		1-16
1-17	7	CLO-SCH	1	0	35	36	4	54	49	.41	0	1	3	2	1	0	A	1-1,093	B-4	CLO 9CWB S3 DON 9CHC S3 SCH	V2		1-17
1-18	9	CLO-MAM	-1	-1	31	29	8	∞	45	.56	1	1	1295	168	67	0	A	1-1,138	B-6	CLO 9CVX S3 DON 9EPN V2 MAM	V2		1-18
1-19	12	CLO-DON	0	1	40	37	3	∞	∞	0	0	0	19	7	5	0	A	1-1,204	B-7	CLO 9CVW V2 DON	S1		1-19
1-20	14	CLO-LKS	2	1	33	32	8	50	47	.55	0	0	224	2	0	0	A	1-1,222	A-8	CLO 9CVV V2 DON	V2		1-20
1-21	69	FEL-HIN	2	1	43.5	44	4	53	50	.45	0	0	4	3	3	0	A	2-1,356	C	FEL 9ACF S3 HIN	S3		1-21
1-22	77	FEL-HIN	1	0	42.5	34.5	5	55	50	.36	6	0	3	2	1	4	A	2-2,052	C	FEL 9ACL S3 HIN	S3		1-22
1-23	136	FEL-HIN	1	1	45.5	43	4	55	49	.40	0	0	0	0	0	0	A	—	—	FEL 9ACF S3 HIN	S3		1-23
1-24	99	FEL-CLO	8	-	35	29	15	50	52	.40	0	2	1237	4	0	0	A	2-2,400	B-9	FEL 9CUV S3 CLO	V2	2	1-24
1-25	96	FEL-HUM	1	0	29.5	30	14	40	37	1.73	2	23	400	80	15	2	A	2-2,346	A-6	FEL 9ACT S3 MRE 9CHN S3 HUM	V2		1-25
1-26	95	FEL-PAT	5	4	30.5	30	10	43	40	1.22	7	3	1030	196	101	15	AB	2-2,312	A-5	FEL 9CEQ V2 MRE 9CWX V2 PAT	V2		1-26
1-27	97	FEL-MRE	3	3	36.5	30.5	9	45	46	.75	2	5	564	137	25	4	A	2-2,387	C	FEL 9ACT S3 MRE	V2		1-27

Table C-1. European IST Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	pJ°	HD 2nd	HD 3rd	HD°	GH -3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
1-28	102	FEL-SCH	3	3	50	46	3	68	49	.37	0	0	0	0	0	0	AB	2-2,450	C	FEL 9CDW V2 SCH	S3		1-28
1-29	103	FEL-MAM	-1	-1	26.5	25	8	45	48	.69	3	3	454	83	17	2	A	2-2,462	C	FEL 9CKA V2 MAM	S1		1-29
1-30	101	FEL-DON	0	0	51	48	2	63	46	.51	0	0	2	2	1	0	A	2-2,438	C	FEL 9CFY V2 DON	S3		1-30
1-31	100	FEL-LKF	1	0	46	38.5	3	56	49	.39	0	0	0	0	0	0	A	2-2,426	C	FEL 9AAB V2 LKF	S1		1-31
1-32	152	HIN-CLO	2	-	23	26	15	46	45	.75	-	-	-	-	-	-	AC	3-2,172	A-2	HIN 9AEA V2 MRE 9CVN V2 CLO	V2		1-32
1-33	154	HIN-CLO	9	7	27	28	10	43	43	1.00	0	2	1624	353	80	6	AC	3-2,232	A-3	HIN 9AEG S3 MRE 9CVN V2 CLO	V1		1-33
1-34	160	HIN-FEL	3	4	40	42	2	57	53	.26	0	0	0	0	0	0	A	3-2,406	C	HIN 9ACA V2 FEL	S3		1-34
1-35	161	HIN-HUM	0	0	32	38	3	50	53	.39	0	0	14	7	1	0	A	3-2,417	C	HIN 9CMN S3 HUM	S1		1-35
1-36	181	HIN-HUM	5	4	35	31	8	39	45	1.26	0	0	1364	65	4	0	ACD	4-2,023	C	HIN 9CMQ S3 HUM	V2		1-36
1-37	166	HIN-PAT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	—	HIN 9AEJ S3 MRE — — PAT	—		1-37
1-38	167	HIN-PAT	-1	-2	32	30.5	6	40	34	2.23	-	-	-	-	-	-	AD	4-1,008	C	HIN 9AEJ S3 MRE 9DDA V2 PAT	V2		1-38
1-39	169	HIN-MRE	0	0	32	30	[illegible]	∞	45	.56	1	13	1391	222	29	1	ABD	4-1,015	A-8	HIN 9AEB V2 MRE	V2		1-39
1-40	164	HIN-SCH	7	7	35.5	36.5	3	55	47	.48	0	0	51	6	1	2	AD	4-1,000	C	HIN 9ADC V2 LKF 9CJQ V2 SCH	S3		1-40
1-41	159	HIN-MAM	4	4	44.5	41	2	64	54	.21	0	0	3	2	2	0	A	3-2,364	A-5	HIN 9CMF V2 MAM	S3		1-41
1-42	171	HIN-DON	9	8	38	39	3	58	49	.38	0	0	1	0	0	0	A	4-1,051	C	HIN 9DZM S3 DON	S3		1-42
1-43	170	HIN-LKF	1	1	42	42	3	∞	47	.45	0	0	0	0	0	0	AD	4-1,036	A-9	HIN 9ADP S3 LKF	S3		1-43
													SECONDARY ROUTINGS										
1-44	39	CLO-HIN	0	1	33	32	10	48	45	.69	0	1	787	13	7	0	AB	1-2,160	A-4	CLO 9CVD S3 FEL 9ACF S3 HIN	V2	5	1-44
1-45	51	CLO-HIN	6	5	33	31	14	49	44	.72	1	2	441	28	18	4	AB	1-2,510	C	CLO 9CVW S3 FEL 9ACH S3 HIN	V2		1-45
1-46	53	CLO-HIN	8	8	31	30	16	45	44	.84	0	1	1231	53	10	0	AB	2-1,019	B-8	CLO 9CUW S3 FEL 9ACG S3 HIN	S1		1-46
1-47	36	CLO-FEL	2	1	37	39	3	∞	43	.71	0	0	11	7	1	0	A	1-2,103	C	CLO 9CVX S3 DON — — FEL	S1	6	1-47
1-48	22	CLO-HUM	3	2	27	27	15	∞	39	1.12	11	33	1807	1526	952	41	AB	1-1,329	B-1, E-2	CLO 9CVT V2 DON 9DGC V2 HUM	V2		1-48
1-49	23	CLO-HUM	4	4	26	26	15	44	42	1.01	0	13	1846	1490	135	0	AB	1-1,373	A-9	CLO 9CVV V2 DON 9CGS S3 HUM	V1		1-49
1-50	24	CLO-HUM	9	9	26	24	23	37	42	1.62	1	77	1805	1704	186	1	AB	1-1,407	C	CLO 9DQG V2 DON 9CGS S3 HUM	V2	7	1-50
1-51	25	CLO-PAT	2	1	32	27	9	41	38	1.54	28	139	1510	451	63	3	A	1-1,423	B-1	CLO 9DQH S3 DON 9DAB V2 PAT	V2		1-52

Table C-1. European IST Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
1-52	35	CLO-MRE	4	2	24	26	14	45	46	.75	1	6	795	319	8	97	AC	—	—	CLO 9CVE S3 FEL 9ACN V2 MRE	V1	8	1-52
1-53	30	CLO-SCH	4	3	34	30	11	53	45	.60	0	3	330	3	0	2	ABC	1-2,043	B-10	CLO 9CVD S3 FEL 9CDW V2 SCH	V2		1-53
1-54	29	CLO-MAM	7	5	30	28	16	49	46	.61	-	-	-	-	-	-	A	—	—	CLO 9CVB S3 FEL 9CKM V2 MAM	V1		1-54
1-55	31	CLO-DON	1	0	35	31	10	∞	44	.63	0	0	85	1	1	0	ABC	1-2,060	A-2	CLO 9CVG S3 FEL 9CGB V2 DON	V2		1-55
1-56	32	CLO-LKF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	CLO 9CVC S3 FEL — — LKF	—		1-56
1-57	33	CLO-LKF	3	1	34	33	8	42	47	.91	2	3	29	0	0	2	A	1-2,081	A-3	CLO 9CVC S3 FEL 9ABU S3 LKF	V1	9	1-57
1-58	79	FEL-HIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	FEL 9CKD S3 MAM 9CLM S3 HIN	—		1-58
1-59	130	FEL-HIN	7	6	29	31	6	51	45	.63	1	31	757	176	62	11	A	3-1,375	B-1	FEL 9EPR V2 MAM 9CLL S3 HIN	S3		1-59
1-60	109	FEL-CLO	10	9	37.5	34	5	52	46	.56	4	2	33	17	10	0	A	3-1,049	C	FEL 9CFM V2 DON 9CVU V2 CLO	S3		1-60
1-61	104	FEL-HUM	-2	-3	33	39.5	15	42	41	1.19	5	7	1558	189	25	1	A	2-2,475	A-7	FEL 9CGA V2 DON — — HUM	V1		1-61
1-62	105	FEL-PAT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	FEL 9CFB V2 DON — — PAT	—		1-62
1-63	107	FEL-MRE	2	1	33.5	33	12	41	38	1.54	5	5	357	46	13	0	AC	3-1,026	B-9	FEL 9CFA V2 DON 9CKR S3 MRE	V2		1-63
1-64	112	FEL-SCH	2	2	29.5	32	5	39	65	1.12	1	1	130	6	0	1	A	3-1,088	C	FEL 9CFN V2 DON 9CGZ V2 SCH	S1		1-64
1-65	128	FEL-MAM	0	0	26.5	31	8	53	42	.82	0	0	347	110	47	4	A	3-1,241	A-4	FEL 9CFZ V2 DON 9CJC V2 MAM	V2	10	1-65
1-66	108	FEL-DON	3	2	37	40	1	49	44	.72	0	0	0	0	0	0	A	3-1,043	C	FEL 9AAA V2 LKF 9CCF S3 DON	V2		1-66
1-67	113	FEL-LKF	-1	-1	44	41	4	54	41	.91	0	0	10	10	5	0	A	3-1,096	C	FEL 9CGB V2 DON 9CCN V2 LKF	V2		1-67
1-68	156	HIN-CLO	10	10	28.5	27	15	48	48	.56	0	2	1873	509	4	1	ABD	3-2,289	C	HIN 9ACF S3 FEL 9CUY S3 CLO	V2		1-68
1-69	178	HIN-FEL	0	0	29	30	14	∞	45	.56	0	10	1443	485	42	0	AD	—	—	HIN 9CLJ S3 MAM 9CKA V2 FEL	S1		1-69
1-70	162	HIN-HUM	2	1	30.5	28	12	43	42	1.06	0	3	1470	82	13	0	ABCD	3-2,429	A-7	HIN 9ADB V2 LKF 9CCC V2 DON 9CGN V2 HUM	V1		1-70
1-71	168	HIN-PAT	9	7	19	24	10	39	48	1.19	4	10	1219	1076	98	23	AC	—	—	HIN 9CMF V2 MAM 9CJB V2 DON — — PAT	V2		1-71
1-72	180	HIN-PAT	-4	[illegible]	32	33	17	∞	41	.89	0	9	1757	370	55	0	AD	4-2,000	A-3	HIN 9CLJ S3 MAM 9CJB V2 DON 9DAD S3 PAT	V2	11	1-72
1-73	173	HIN-MRE	9	9	28.5	27.5	12	∞	43	.71	-	-	-	-	-	-	AD	4-1,173	C	HIN 9ACD V2 FEL 9CEQ V2 MRE	V2		1-73
1-74	175	HIN-SCH	6	6	38	38	2	54	47	.49	-	-	-	-	-	-	AD	4-[illegible],109	C	HIN 9ACD V2 FEL 9CDM V2 SCH	S3		1-74
1-75	179	HIN-DON	3	3	32.5	30.5	6	∞	∞	0	0	0	640	186	108	1	AD	4-1,124	A-2	HIN 9CLJ S3 MAM 9CJA V2 DON	V2		1-75
1-76	177	HIN-LKF	5	5	36.5	37	4	51	43	.76	-	-	-	-	-	-	A	4-1,115	C	HIN 9ACD V2 FEL 9AAL V2 LKF	S1		1-76

Table C-1. European IST Loops (Sheet 2 Continued)

Table #	Cell #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	P_J^o	HD 2nd	HD 3rd	HD%	GH -3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
												TERNARY ROUTINGS											
1-77	106	FEL-HUM	3	2	38	39	2	49	43	.79	0	0	9	6	2	0	AD	3-1,000	A-8	FEL 9ACD V2 HIN 9CMR S3 HUM	V2		1-77
1-78	172	HIN-HUM	8	6	25	25.5	18	43	49	.45	-	-	-	-	-	-	ABD	4-1,057	A-10	HIN 9ACD V2 FEL 9CEQ V2 MRE 9CHQ S3 HUM	V2		1-78
1-79	174	HIN-DON	4	4	38	40	2	54	45	.60	-	-	-	-	-	-	AD	4-1,088	A-1	HIN 9ACD V2 FEL 9CFZ V2 DON	V2		1-79
1-80	176	HIN-DON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	—	HIN 9ACD V2 FEL — — DON	—		1-80
												NON-ENGINEERED ROUTINGS											
1-81	43	CLO-HIN	-2	-4	33	32	9	49	41	.89	3	9	268	83	27	0	A	1-2,270	A-6	CLO 9CVU V2 DON 9DTY V2 MAM 9CMA S3 HIN	V2	12	1-81
1-82	45	CLO-HIN	-4	-4	35	33	8	40	32	2.70	0	0	157	56	14	0	AD	1-2,320	A-7	CLO 9CVS S3 MRE — — HUM 9CMP S3 HIN	V2		1-82
1-83	81	FEL-HIN	12	9	23	26	13	37	42	1.62	1	6	1789	877	44	1	A	2-2,104	B-4	FEL 9CFC V2 DON 9DQU V2 HUM 9CMT V2 HIN	V1	13	1-83
1-84	134	FEL-HIN	3	2	30.5	28.5	15	-	-	-	-	-	-	-	-	-	-	—	—	FEL 9CFB V2 DON — — HUM 9CMR S3 HIN	—		1-84
1-85	132	FEL-HIN	-2	-3	27.5	26	14	38	39	1.69	15	140	1787	1322	314	13	A	3-1,441	C	FEL 9CEP V2 MRE 9AEA V2 HIN	V1		1-85

Table C-2. European Access Loops (Sheet 1)

Table #	Ckt #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	R	DIG.	Dist.	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
2-1	1	Coltano, Italy - Aviano, Italy	11/3	1216	2.48E-3	0	100	8	0	0	0	0	0	492	2.48E-3	2.61E-3	2.18E-3	2.72E-3	4-4	21	2-1
2-2	18	Coltano, Italy - Aviano, Italy	11/5	0950	2.75E-5	0	100	8	0	0	0	0	0	492	2.75E-5	3.00E-5	-	-	4-4	27	2-2
2-3	3	Coltano, Italy - Vicenza, Italy	11/4	0835	1.87E-6	0	100	8	0	0	0	0	0	394	1.87E-6	3.12E-5	-	-	4-3	28	2-3
2-4	10	Coltano, Italy - Vicenza, Italy	11/5	1034	3.62E-5	0	100	8	0	0	0	0	0	394	3.62E-5	5.75E-5	-	-	4-3	19	2-4
2-5	20	Coltano, Italy - Vicenza, Italy	11/5	1136	3.75E-5	2.50E-6	100	8	0	0	0	0	0	394	3.75E-5	3.12E-5	1.87E-5	5.00E-6	4-4	27	2-5
2-6	5	Coltano, Italy - Leghorn, Italy	11/4	0945	0	0	100	0	0	0	0	2	0	10	0	0	-	-	4-4	31	2-6
2-7	26	Coltano, Italy - Leghorn, Italy	11/5	1550	0	-	-	0	0	0	0	2	0	10	0	0	0	-	5-4	31	2-7
2-8	70	Feldberg, Germ - Bremerhaven, Germ	11/15	1003	7.75E-4	5.00E-5	96	8	2	0	0	0	0	502	7.75E-4	6.54E-4	7.01E-4	5.12E-4	5-4	27	2-8
2-9	91	Feldberg, Germ - Bremerhaven, Germ	11/16	1527	2.69E-3	5.00E-6	96	8	2	0	0	0	0	502	2.69E-3	1.84E-3	2.26E-3	2.43E-3	4-4	27	2-9
2-10	71	Feldberg, Germ - Berlin, Germ	11/15	1040	2.85E-2	4.64E-4	94	2	4	0	0	0	0	654	2.85E-2	2.88E-2	3.71E-2	1.75E-2	4-4	22	2-10
2-11	73	Feldberg, Germ - Berlin, Germ	11/15	1254	4.04E-4	2.13E-5	96	2	0	0	2	0	0	544	4.04E-4	3.94E-4	2.20E-4	1.95E-4	4-4	27	2-11
2-12	92	Feldberg, Germ - Berlin, Germ	11/16	1552	1.14E-2	0	100	4	4	0	0	0	0	654	1.14E-2	1.38E-2	2.21E-2	2.09E-2	4-4	27	2-12
2-13	74	Feldberg, Germ - Stuttgart, Germ	11/15	1320	6.53E-3	0	100	6	2	0	0	0	2	396	6.53E-3	5.86E-4	4.16E-4	6.00E-4	5-5	26	2-13
2-14	124	Feldberg, Germ - Stuttgart, Germ	11/18	1550	3.75E-6	6.75E-5	99	14	0	0	0	0	0	830	3.75E-6	1.12E-4	1.25E-6	1.25E-6	4-4	26	2-14
2-15	75	Feldberg, Germ - Vaihingen, Germ	11/15	1352	4.94E-4	0	100	6	2	0	0	0	0	378	4.94E-4	5.05E-4	4.58E-4	3.01E-4	5-4	25	2-15
2-16	89	Feldberg, Germ - Frankfort, Germ	11/16	1415	0	0	100	2	0	0	0	0	0	22	0	0	2.50E-6	0	4-4	31	2-16
2-17	90	Feldberg, Germ - Heidelberg, Germ	11/16	1500	2.53E-3	3.63E-3	97	6	2	0	0	2	6	530	2.53E-3	3.44E-3	2.55E-3	2.58E-3	9-7	22	2-17
2-18	93	Feldberg, Germ - Lindsey, Germ	11/16	1615	6.35E-3	3.12E-5	99	0	0	2	0	0	0	32	1.94E-4	9.53E-5	3.95E-4	5.12E-5	5-4	27	2-18
2-19	116	Feldberg, Germ - Lindsey, Germ	11/18	1010	5.50E-5	0	100	0	0	2	0	0	0	32	5.50E-5	7.62E-5	9.37E-5	7.62E-5	5-4	28	2-19
2-20	110	Feldberg, Germ - Bad Munder, Germ	11/17	1545	8.75E-6	0	100	8	2	0	0	0	0	314	8.75E-6	1.62E-5	1.87E-5	0	5-4	29	2-20
2-21	123	Feldberg, Germ - Wasserkuppe, Germ	11/18	1535	0	0	100	2	0	0	0	0	0	132	0	2.50E-6	4.12E-6	2.50E-6	5-4	28	2-21
2-22	125	Feldberg, Germ - Hahn, Germ	11/18	1623	0	0	100	4	0	0	0	0	0	198	0	5.12E-5	0	0	5-4	30	2-22
2-23	126	Feldberg, Germ - Goblingen, Germ	11/18	1640	1.45E-3	0	100	20	0	0	0	0	0	528	1.45E-3	2.88E-3	1.93E-3	1.51E-3	4-4	23	2-23
2-24	137	Feldberg, Germ - Bonn, Germ	11/19	1426	1.24E-4	0	100	4	0	0	0	0	0	164	0	0	1.25E-6	0	4-4	30	2-24
2-25	138	Hillingdon, Eng - Croughton, Eng	11/23	0928	1.00E-5	0	100	6	0	0	0	0	0	92	1.00E-5	3.00E-5	3.00E-5	8.75E-6	4-4	27	2-25
2-26	145	Hillingdon, Eng - Croughton, Eng	11/23	1515	2.65E-4	0	100	6	0	0	0	0	0	92	5.46E-5	3.75E-5	5.50E-5	5.37E-5	4-4	27	2-26

Table C-2. European Access Loops (Sheet 1 Continued)

[illegible]	Col.	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	R	DIG.	Dist.	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table
2-27	147	Hillingdon, Eng - Croughton, Eng	11/23	1645	5.00E-6	0	100	12	0	0	0	0	0	256	5.00E-6	2.50E-6	3.75E-6	1.25E-6	4-4	29	2-27
2-28	139	Hillingdon, Eng - Chicksands, Eng	11/23	1002	1.12E-5	0	100	0	0	0	2	0	0		1.12E-5	8.25E-5	1.87E-5	2.00E-5	4-4	25	2-28
2-29	140	Hillingdon, Eng - Mildenhall, Eng	11/23	1028	0	0	100	6	0	0	0	0	0	146	0	1.00E-5	2.08E-6	0	4-4	30	2-29
2-30	141	Hillingdon, Eng - Londonderry, N. Ire	11/23	1050	1.89E-4	0	100	0	0	0	2	0	0	860	1.89E-4	6.62E-4	2.54E-4	3.32E-4	5-4	24	2-30
2-31	148	Hillingdon, Eng - Londonderry, N. Ire	11/23	1705	1.37E-5	0	100	0	0	0	2	0	0	860	1.37E-5	4.62E-5	4.00E-5	1.37E-5	4-4	27	2-31
2-32	142	Hillingdon, Eng - Upper Heyford, Eng	11/23	1120	1.06E-3	0	100	14	0	0	0	0	0	266	1.06E-3	1.10E-3	1.14E-3	1.08E-3	4-4	22	2-32
2-33	143	Hillingdon, Eng - London, Eng	11/23	1145	4.70E-5	0	100	0	0	0	2	0	0	20	4.70E-5	1.91E-4	1.25E-4	9.87E-5	4-4	22	2-33
2-34	146	Hillingdon, Eng - London, Eng	11/23	1615	0	0	100	4	0	0	0	0	0	86	0	0	0	0	4-4	29	2-34

Table C-2. European Access Loops (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
2-1	1	CLO-AVO	-3	-4	43	38	6	49	34	2.03	0	0	2	1	0	0	A	1-1,000	B-1	CLO 9CTL V2 AVO	S1		2-1
2-2	18	CLO-AVO	-2	-2	41	36.5	6	53	43	.74	0	0	5	1	0	0	AB	1-1,251	B-7	CLO 9DSM V2 AVO	V2		2-2
2-3	3	CLO-VCA	0	0	39.5	36.5	4	43	50	.77	0	0	14	9	6	0	A	1-1,033	A-3	CLO 9CUP V2 VCA	S1	14	2-3
2-4	19	CLO-VCA	-1	-2	36	35.5	4	43	44	.95	-	-	-	-	-	-	-	-	-	CLO - - VCA	-		2-4
2-5	20	CLO-VCA	-2	-3	49.5	46	4	46	43	.87	0	0	48	13	7	0	AB	1-1,270	B-9	CLO 9CUT V2 VCA	V2	15	2-5
2-6	5	CLO-LEG	0	0	65.5	66	0	59	48	.41	0	0	0	0	0	0	A	1-1,070	B-5	CLO 9DUK V2 LEG	S3		2-6
2-7	26	CLO-LEG	0	0	65.5	57	0	55	47	.46	0	0	0	0	0	0	A	1-1,445	A-10	CLO - - LEG	S3		2-7
2-8	70	FEL-BRN	1	1	35.5	35	7	54	47	.49	0	3	478	214	37	0	A	2-1,370	B-1	FEL 9AJF V2 BRN	V2		2-8
2-9	91	FEL-BRN	2	1	30	34	5	44	50	.70	0	12	669	408	100	0	A	2-2,251	C	FEL 44CZG2-2 BRN	S1		2-9
2-10	71	FEL-BLN	2	2	30	32	8	∞	∞	0	1	0	1031	294	59	3	AC	2-1,399	B-2	FEL 9AUV V2 BLN	S1		2-10
2-11	73	FEL-BLN	7	9	38.5	36	5	42	39	1.12	1	2	357	96	26	1	A	2-1,455	B-3	FEL 9AUT V2 BLN	V1		2-11
2-12	92	FEL-BLN	5	5	37	38	3	∞	50	.32	0	0	26	14	9	0	AC	2-2,260	A-4	FEL 44CMN8-8 FKT 44UZB3-9 BLN	S1	16	2-12
2-13	74	FEL-SGT	2	1	42	36	6	47	44	.77	20	0	0	0	0	0	A	2-2,000	B-4	FEL 44CZH1-1 VHN WBVN V1 SGT	V2		2-13
2-14	124	FEL-SGT	-3	-3	45	36	6	53	46	.55	0	0	0	0	0	0	A	3-1,188	A-4	FEL 9CUW V2 SGT	S1		2-14
2-15	75	FEL-VHN	2	1	42	41	3	44	48	1.09	21	0	0	0	0	0	A	2-2,018	B-4	FEL 44CZH1-1 VHN	V2	17	2-15
2-16	89	FEL-FKT	1	0	48.5	47	1	65	49	.35	0	0	0	0	0	0	A	2-2,213	C	FEL 44CMN8-12 FKT	S3		2-16
2-17	90	FEL-HDG	9	7	38	31.5	4	∞	45	.56	19	0	1309	58	0	0	A	2-2,221	A-3	FEL 44CZH1-1 VHN 44UMJJ-24 SGT WFQ4 KSL R HDG	V1	18	2-17
2-18	93	FEL-LSY	2	2	32	33	3	42	49	.87	2	1	879	161	3	0	A	2-2,290	C	FEL 44JMP1-9 LSY	S1		2-18
2-19	116	FEL-LSY	0	0	46	39	1	50	44	.70	0	0	6	1	1	0	A	3-1,127	A-1	FEL 44JMP9-10 LSY	S1		2-19
2-20	110	FEL-BDM	1	1	41	41	2	49	46	.61	0	0	2	1	0	0	A	3-1,056	A-9	FEL 44JZB1-6 BDM	V1		2-20
2-21	123	FEL-WSE	1	1	54	41	2	57	48	.42	0	0	0	0	0	0	A	3-1,183	C	FEL 44JMN4-4 WSE	S1	19	2-21
2-22	125	FEL-HAN	1	0	50	49	1	49	48	.53	-	-	-	-	-	-	A	3-1,211	C	FEL 44JM14-8 HAN	S1		2-22
2-23	126	FEL-GAB	-3	-4	43	42	6	60	48	.41	0	0	0	0	0	0	ABC	3-1,218	C	FEL WF8L V1 GAB	S1	20	2-23
2-24	137	FEL-BAN	1	0	49	45	1	57	49	.38	0	0	0	0	0	0	A	3-2,000	C	FEL WEGV V1 BAN	S1		2-24
2-25	138	HIN-CRO	1	0	44	37	5	60	48	.41	0	0	6	5	4	0	A	3-2,009	A-8	HIN 9ECY V2 CRO	V2		2-25

Table C-2. European Access Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
2-26	145	HIN-CRO	2	2	37	36	6	56	45	.58	0	0	315	10	4	0	A	3-2,113	A-1	HIN 9ECX V2 CRO	S1		2-26
2-27	147	HIN-CRO	2	2	38	38	2	56	58	.20	0	0	9	2	1	0	A	3-2,142	C	HIN 33JMB3-10 CRO	S1		2-27
2-28	139	HIN-CKS	0	3	51	50.5	0	52	40	1.03	0	0	0	0	0	0	A	3-2,027	B-4	HIN 9DPC V2 CKS	V2		2-28
2-29	140	HIN-MIL	0	-1	54	46	1	51	51	.40	0	0	5	2	0	0	A	3-2,041	C	HIN 9DWB V2 MIL	S3		2-29
2-30	141	HIN-LDR	2	0	38.5	37	3	42	38	1.49	0	0	35	20	3	0	A	3-2,046	A-9	HIN 9AKL V2 LDR	V2	21	2-30
2-31	148	HIN-LDR	1	-	36.5	29	2	47	50	.55	0	0	199	16	3	0	A	3-2,150	C	HIN 9BUV V2 LDR	S1		2-31
2-32	142	HIN-UHD	-1	0	38	32	6	49	41	.96	0	0	74	38	26	1	A	3-2,066	C	HIN 9DND S3 UHD	S1		2-32
2-33	143	HIN-LDN	3	2	42	43	.5	54	39	1.14	0	0	0	0	0	0	A	3-2,075	A-10	HIN 9DCL V2 LDN	V1		2-33
2-34	146	HIN-LDN	4	3	47	45	2	61	60	.13	0	0	0	0	0	0	A	3-2,136	C	HIN 33EMA5-10 LDN	S3		2-34

Table C-3. European Remote Access Loops (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	LC	Dist	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
3-1	8	Coltano, Italy - Athens, Greece	11/4	1105	2.80E-3	2.67E-4	87	6	6	0	2	0	1688	2.80E-3	2.65E-3	-	-	6-5	22	3-1
3-2	60	Coltano, Italy - Iraklion, Crete	11/10	1318	5.89E-3	1.44E-3	95	4	8	0	0	0	2012	5.89E-3	6.32E-3	5.82E-3	6.33E-3	4-4	20	3-2
3-3	61	Coltano, Italy - Ankara, Turkey	11/10	1410	5.36E-3	7.50E-6	98	4	10	0	2	0	2838	5.36E-3	1.04E-2	5.77E-3	7.58E-3	4-4	23	3-3
3-4	63	Coltano, Italy - Ankara, Turkey	11/10	1550	1.26E-2	9.75E-5	77	4	10	0	2	0	2838	1.26E-2	1.18E-2	1.41E-2	2.30E-2	6-5	18	3-4
3-5	118	Feldberg, Italy - Ankara, Turkey	11/18	1325	3.46E-2	-	-	22	16	0	0	0	4460	3.46E-2	4.23E-2	5.46E-2	3.27E-2	2-2	18	3-5
3-6	119	Feldberg, Italy - Ankara, Turkey	11/18	1336	7.79E-2	-	-	22	16	0	0	0	4460	7.79E-2	9.02E-2	6.40E-2	8.06E-2	4-2	17	3-6
3-7	120	Feldberg, Italy - Ankara, Turkey	11/18	1425	6.38E-2	-	-	22	16	0	0	0	4460	6.38E-2	-	6.42E-2	-	1-1	19	3-7
3-8	182	Hillingdon, Eng - Ankara, Turkey	11/26	1635	4.94E-2	4.95E-4	67	4	20	0	6	2	7316	4.94E-2	5.83E-2	4.23E-2	4.75E-2	3-3	17	3-8
3-9	21	Coltano, Italy - Torrejon, Spain	11/5	1205	1.58E-1	2.67E-2	-	24	10	4	0	0	3888	1.58E-1	-	2.06E-1	1.71E-1	4-3	15	3-9
3-10	64	Coltano, Italy - Torrejon, Spain	11/10	1620	1.43E-2	1.87E-5	96	4	8	0	2	0	2392	1.43E-2	1.21E-2	1.62E-2	1.27E-2	7-5	23	3-10
3-11	68	Coltano, Italy - Torrejon, Spain	11/11	1113	2.67E-3	5.37E-5	68	4	8	0	2	0	2392	2.67E-3	5.41E-3	4.59E-3	4.49E-3	4-4	23	3-11
3-12	65	Coltano, Italy - Sidi Yahia, Morrocco	11/11	0900	4.88E-2	4.10E-4	79	2	10	0	4	0	-	3.73E-2	3.62E-3	3.62E-3	4.80E-2	3-3	18	3-12
3-13	66	Coltano, Italy - Sidi Yahia, Morrocco	11/11	0955	3.77E-2	2.31E-4	83	2	10	0	4	0	-	3.77E-2	4.59E-2	6.98E-2	3.93E-2	3-3	18	3-13
3-14	67	Coltano, Italy - Sidi Yahia, Morrocco	11/11	0955	2.92E-3	5.25E-5	98	2	8	0	4	0	-	2.92E-3	4.97E-3	4.93E-3	4.66E-3	4-4	20	3-14
3-15	86	Feldberg, Germ - Dye 5, Iceland	11/16	1125	4.30E-2	4.81E-3	57	2	14	2	0	0	-	4.30E-2	5.43E-2	6.11E-2	5.45E-2	4-4	22	3-15
3-16	117	Feldberg, Germ - Dye 5, Iceland	11/18	1040	1.36E-2	2.95E-3	91	2	14	2	0	0	-	1.36E-2	7.44E-3	5.39E-3	3.99E-3	4-4	21	3-16
3-17	144	Hillingdon, Eng - Keflavik, Iceland	11/23	1220	1.40E-1	2.44E-2	13	4	14	2	0	0	-	1.40E-1	1.57E-1	1.81E-1	1.55E-1	4-4	16	3-17
3-18	82	Feldberg, Germ - Reese-Augsburg, Germ	11/16	0913	1.06E-2	1.37E-5	99	10	0	0	0	0	486	3.67E-3	4.04E-3	4.70E-3	7.32E-3	4-4	22	3-18
3-19	84	Feldberg, Germ - Ramstein, Germ	11/16	1025	1.75E-5	0	100	6	0	0	0	0	228	1.75E-5	1.66E-5	5.00E-6	2.50E-6	5-4	28	3-19
3-20	85	Feldberg, Germ - Croughton, Eng	11/16	1047	2.12E-5	3.75E-6	99	32	0	0	0	0	934	2.12E-5	0	1.25E-6	0	5-4	28	3-20
3-21	87	Feldberg, Germ - Laken Heath, Eng	11/16	1250	0	0	100	34	0	0	0	0	996	0	0	0	0	15-12	29	3-21
3-22	88	Feldberg, Germ - Vicenzo, Italy	11/16	1340	1.60E-2	5.00E-6	99	36	0	0	0	0	2076	1.60E-2	4.51E-2	2.17E-2	1.68E-2	5-3	20	3-22
3-23	114	Feldberg, Germ - Vicenzo, Italy	11/18	0930	1.05E-2	-	-	28	0	0	0	0	1474	1.05E-2	1.26E-2	1.20E-2	-	2-2	21	3-23
3-24	115	Feldberg, Germ - Vicenzo, Italy	11/18	0948	2.29E-3	0	100	28	0	0	0	0	1474	2.29E-3	2.64E-3	3.08E-3	2.38E-3	4-4	23	3-24
3-25	183	Hillingdon, Eng - Bremerhaven, Germ	11/26	1707	1.04E-4	0	100	34	2	0	0	0	1344	1.04E-4	3.31E-4	9.26E-4	1.83E-4	4-4	26	3-25
3-26	226	Hillingdon, Eng - Spangdahlem, Germ	12/2	1420	1.36E-4	6.25E-5	96	26	0	0	0	0	776	1.36E-4	2.00E-4	2.19E-4	1.82E-4	7-5	21	3-26

Table C-3. European Remote Access Loops (Sheet 2)

Table #	Cell #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	P_J^o	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
3-1	8	CLO-ATH	10	9	30	29	7	46	48	.64	2	4	708	167	94	7	A	1-1,110	A-5	CLO 9CVN V2 MRE 9CWZ V2 PAT 9EPK V2 ATH	V2		3-1
3-2	60	CLO-IRK	5	3	29	30	9	40	35	2.04	1	0	1039	51	7	0	AB	2-1,110	A-1	CLO 9CVN V2 MRE - - PAT - - IRK	V1		3-2
3-3	61	CLO-ANK	9	8	27.5	28.5	10	42	38	1.26	2	!	1573	233	59	3	ABC	2-1,136	A-3	CLO 9CVN V2 MRE 9CXD S3 PAT 9CXH V2 ANK	V2		3-3
3-4	63	CLO-ANK	5	5	31.5	30	10	41	38	1.54	0	1	1355	400	166	0	AD	2-1,197	A-4	CLO 9CVR S3 MRE 9CXE S3 PAT 9CSE V2 ANK	V2		3-4
3-5	118	FEL-ANK	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FEL 9CEX V2 MRE - - PAT 9CSD S3 ANK	-		3-5
3-6	119	FEL-ANK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FEL - - MRE - - PAT - - ANK	-		3-6
3-7	120	FEL-ANK	11	11	24	25	17	∞	43	.71	-	-	-	-	-	-	A	-	-	FEL - - MRE - - PAT - - ANK	V2		3-7
3-8	182	HIN-ANK	13	11	24	25	16	34	39	2.29	-	-	-	-	-	-	ABD	-	-	HIN 9CMQ S3 HUM - MRE - PAT 9CXH V2 ANK	V1		3-8
3-9	21	CLO-TJN	14	13	18	19	25	∞	∞	0	-	-	-	-	-	-	AB	1-1,319	C, E-10	CLO 9CVI V2 DON 9DGC S3 HUM 9DEL V2 TJN	V2		3-9
3-10	64	CLO-TJN	11	10	27.5	29	10	40	38	1.61	0	3	1732	754	135	0	AC	2-1,223	A-5	CLO 9CVN V2 MRE 9CHX S3 HUM 9DEL V2 TJN	V2		3-10
3-11	68	CLO-TJN	7	6	31.5	29	8	40	44	1.18	1	7	1371	213	44	2	A	2-1,288	A-8	CLO 9CVN V2 MRE - S3 HUM 9BYN V2 TJN	V2		3-11
3-12	65	CLO-SYH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	-	-	CLO - - MRE - - HUM - - SYH	-		3-12
3-13	66	CLO-SYH	10	9	27	28	10	∞	41	.89	0	9	1854	950	184	2	ABC	-	-	CLO 9CVN V2 MRE - S3 HUM 9BXW S3 SYH	V2	22	3-13
3-14	67	CLO-RTA	6	6	30	29	12	40	40	1.41	0	3	1733	286	29	0	AB	2-1,250	A-7	CLO 9CVN V2 MRE - S3 HUM 9BXJ V2 RTA	V2		3-14
3-15	86	FEL-DIC	-1	-3	26	25	15	47	∞	.45	2	51	1613	646	259	18	AC	2-2,176	A-1	FEL 34JZB3-8 MAM 33JTD2-3 DIC	S1	23	3-15
3-16	117	FEL-DIC	1	0	30	30	11	41	49	.96	0	5	1712	545	75	0	A	3-1,152	B-2	FEL 34JZA6-3 MAM 33JTD2-11 DIC	S3		3-16
3-17	144	HIN-KEF	14	13	17.5	17.5	26	41	35	1.99	3	41	1973	2007	1907	23	AC	3-2,098	C	HIN 9CMF V2 MAM 9BQJ V2 KEF	S1		3-17
3-18	82	FEL-RAG	6	6	34	30	15	∞	48	.40	10	25	253	70	42	4	ABC	2-2,121	A-9	FEL 9AAF V2 LKF 44CMM5-6 GAB WC5M V1 RAG	V2	24	3-18

Table C-3. European Remote Access Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
3-19	84	FEL-RSN	2	1	45	37	4	51	46	.57	1	0	29	0	0	1	A	2-2,146	A-10	FEL 44JMQ5-11 LKF 44CMJ4-3 DON WGNL V1 RSN	V2		3-19
3-20	85	FEL-CRO	1	1	44	39	6	51	57	.31	0	0	4	3	3	0	A	2-2,170	C	FEL 34JMA4-4 HIN 9GTN D1 CRO	S1		3-20
3-21	87	FEL-LAH	4	3	43	42.5	4	56	48	.43	0	0	0	0	0	0	A	2-2,207	C	FEL 34JMA4-4 HIN WEFV V1 LAH	S1		3-21
3-22	88	FEL-VCA	12	12	27	25	14	47	[illegible]	.45	-	-	-	-	-	-	AB	-	-	FEL 9CUY S3 CLO 9CUM V2 VCA	V2	25	3-22
3-23	114	FEL-VCA	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	FEL 9CUX V2 CLO 9DGB V2 VCA	-		3-23
3-24	115	FEL-VCA	6	5	33	32	9	47	43	.84	4	0	1941	1993	1883	1	A	3-1,102	A-10	FEL 9CUX V2 CLO 9DGB V2 VCA	V2		3-24
3-25	183	HIN-BRN	6	6	37	38	5	56	51	.32	1	4	11	5	3	0	A	4-2,030	A-4	HIN 9ACJ S3 FEL 44CZG1-4 BRN	S1		3-25
3-26	226	HIN-SPM	10	10	36	32	16	48	39	1.19	3	24	228	200	172	7	AB	5-1,091	A-5	HIN 9ADP S3 LKF 9CJN V2 SCH 9BRM SPM	S1	26	3-26

Table C-4. European One-Way IST Calls (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	M	T	D	L	LC	Dist	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-CH	Sync Tries-Hits	S/N	Table #
4-1	37	Coltano, Italy - Hillingdon, Eng	11/8	1445	1.40E-4	2.50E-6	100	23	0	0	0	0	961	1.40E-4	1.22E-4	1.19E-4	1.80E-4	3-3	25	4-1
4-2	38	Coltano, Italy - Hillingdon, Eng	11/8	1515	7.00E-6	1.32E-3	100	23	0	0	0	0	961	7.00E-6	2.30E-5	3.12E-5	6.50E-5	5-5	25	4-2
4-3	135	Feldberg, Germ - Hillingdon, Eng	11/19	1330	0	0	100	13	0	0	0	0	421	0	0	4.50E-5	0	4-4	30	4-3
4-4	40	Coltano, Italy - Hillingdon, Eng	11/8	1545	5.91E-3	1.50E-5	84	1	4	0	3	1	2119	5.91E-3	3.72E-3	9.72E-3	9.61E-3	5-5	20	4-4
4-5	44	Coltano, Italy - Hillingdon, Eng	11/9	0930	1.11E-4	1.25E-6	99	1	4	0	3	1	2119	1.11E-4	6.76E-4	5.02E-4	1.97E-4	4-4	28	4-5
4-6	48	Coltano, Italy - Hillingdon, Eng	11/9	1145	5.51E-4	4.51E-4	98	1	4	0	3	1	2119	5.51E-4	1.07E-4	3.44E-4	1.21E-4	3-3	28	4-6
4-7	42	Coltano, Italy - Hillingdon, Eng	11/8	1645	5.19E-4	6.25E-5	98	8	3	3	0	0	1024	5.19E-4	4.36E-4	1.92E-4	3.20E-4	4-4	28	4-7
4-8	46	Coltano, Italy - Hillingdon, Eng	11/9	1035	2.48E-3	0	100	16	4	1	1	0	1788	2.48E-3	1.95E-2	2.15E-3	3.67E-3	6-5	19	4-8
4-9	50	Coltano, Italy - Hillingdon, Eng	11/9	1448	8.05E-4	1.00E-5	99	23	0	0	0	0	961	8.05E-4	2.27E-4	1.70E-3	1.33E-4	5-5	25	4-9
4-10	52	Coltano, Italy - Hillingdon, Eng	11/9	1550	8.72E-4	7.50E-6	97	23	0	0	0	0	961	8.72E-4	2.08E-4	3.34E-4	2.29E-5	4-4	25	4-10
4-11	72	Feldberg, Germ - Hillingdon, Eng	11/15	1140	6.25E-6	0	100	13	0	0	0	0	421	6.25E-6	3.62E-5	1.37E-5	7.50E-6	4-4	27	4-11
4-12	76	Feldberg, Germ - Hillingdon, Eng	11/15	1435	6.25E-6	0	100	13	0	0	0	0	421	6.25E-6	8.75E-6	1.25E-6	1.87E-5	5-4	27	4-12
4-13	78	Feldberg, Germ - Hillingdon, Eng	11/15	1530	5.25E-5	0	100	6	2	1	0	0	446	5.25E-5	3.66E-4	1.87E-5	6.37E-5	4-4	28	4-13
4-14	129	Feldberg, Germ - Hillingdon, Eng	11/19	1040	1.01E-3	1.70E-4	93	6	2	1	0	0	446	1.01E-3	7.84E-4	7.12E-4	7.35E-4	4-4	25	4-14
4-15	80	Feldberg, Germ - Hillingdon, Eng	11/15	1630	1.08E-3	1.25E-5	96	1	5	2	2	1	3078	1.08E-3	3.60E-4	5.66E-4	4.60E-4	4-4	22	4-15
4-16	133	Feldberg, Germ - Hillingdon, Eng	11/19	1245	1.35E-2	3.50E-5	87	-	-	-	-	-	-	6.96E-3	1.06E-2	6.25E-3	6.59E-3	6-5	22	4-16
4-17	149	Hillingdon, Eng - Coltano, Italy	11/24	0838	2.40E-3	2.50E-6	99	1	4	0	3	1	2119	2.40E-3	2.37E-3	4.27E-3	3.69E-3	3-3	22	4-17
4-18	153	Hillingdon, Eng - Coltano, Italy	11/24	1115	2.96E-4	0	100	1	4	0	3	1	2119	2.96E-4	7.84E-4	6.86E-4	1.23E-3	5-4	25	4-18
4-19	151	Hillingdon, Eng - Coltano, Italy	11/24	0950	1.07E-2	2.50E-6	99	16	4	1	1	0	1788	1.07E-2	7.57E-3	6.05E-3	5.43E-3	4-4	22	4-19
4-20	131	Hillingdon, Eng - Coltano, Italy	11/19	1140	4.51E-2	3.64E-4	76	26	6	1	0	0	2648	4.51E-2	3.84E-2	4.43E-2	7.11E-2	5-5	21	4-20
4-21	155	Hillingdon, Eng - Coltano, Italy	11/24	1413	4.56E-4	6.25E-5	91	23	0	0	0	0	961	4.56E-4	1.21E-4	9.96E-4	7.22E-4	4-4	22	4-21

Table C-4. European One-Way IST Calls (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	P_J^o	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
4-1	37	CLO-HIN	-1	-1	35	34	7	47	50	.55	0	1	52	42	29	0	ABC	———	—	HIN 9ACF S3 FEL 9CUX V2 CLO	S1		4-1
4-2	38	CLO-HIN	-3	-3	37	33	10	50	51	.42	0	0	19	17	13	0	AB	1-2,108	A-1	HIN 9ACF S3 FEL 9CVD S3 CLO	S1		4-2
4-3	135	FEL-HIN	1	0	48	48	1	55	55	.25	0	0	0	0	0	0	A	3-1,489	A-9	HIN 9ACF S3 FEL	S3		4-3
4-4	40	CLO-HIN	-1	-1	39	37	7	48	37	1.46	1	22	215	103	38	0	ABC	1-2,180	A-2,3	HIN 9CMM S3 HUM 9CHL S3 MRE 9CVR S3 CLO	V2		4-4
4-5	44	CLO-HIN	-5	-5	39	36	6	44	36	1.70	0	0	89	24	6	0	AD	1-2,293	A-1	HIN 9CMP S3 HUM ——— — MRE 9CVS S3 CLO	V2		4-5
4-6	48	CLO-HIN	-5	-5	39	36	6	40	40	1.41	0	0	62	10	2	0	A	———	—	HIN 9CMN S3 HUM ——— — MRE 9CVM V2 CLO	S3		4-6
4-7	42	CLO-HIN	3	2	34	34	7	∞	50	.32	0	2	320	98	20	0	A	1-2,246	A-4	HIN 9CMA S3 MAM 9DTY V2 DON 9CVU V2 CLO	S3		4-7
4-8	46	CLO-HIN	3	3	30	30	12	∞	44	.63	0	6	1275	64	9	0	A	1-2,351	A-2,3,4	HIN 9AEC V2 MRE 9DQF S3 CLO	V2	27	4-8
4-9	50	CLO-HIN	2	2	41	41.5	11	48	45	.69	0	0	3	1	0	0	—	1-2,457	A-5,6	HIN 9ACH S3 FEL 9CUN S3 CLO	—		4-9
4-10	52	CLO-HIN	3	2	39	32	12	52	46	.56	0	1	28	17	9	0	AB	2-1,000	A-8	HIN 9ACG S3 FEL 9CUW S3 CLO	S1		4-10
4-11	72	FEL-HIN	1	1	46.5	47.5	4	55	55	.25	1	0	3	3	2	1	A	2-1,426	A-1	HIN 9ACF S3 FEL	S3		4-11
4-12	76	FEL-HIN	0	1	44	45.5	4	∞	51	.28	0	0	0	0	0	0	A	2-2,035	A-2	HIN 9ACL S3 FEL	S3		4-12
4-13	78	FEL-HIN	1	0	35	34	6	∞	48	.40	0	0	49	22	0	0	A	2-2,059	A-3	HIN 9CLM S3 MAM 9CKD S3 FEL	S3		4-13
4-14	129	FEL-HIN	4	4	31	30	8	47	45	.72	0	3	293	86	30	2	A	3-1,341	A-6	HIN 9CLL S3 MAM 9EPR V2 FEL	S3		4-14
4-15	80	FEL-HIN	7	8	29	29	9	40	46	1.12	0	0	1442	310	26	0	A	2-2,087	A-4	HIN 9CMT V2 HUM 9DQV V2 DON 9CFC V2 FEL	V2		4-15
4-16	133	FEL-HIN	5	4	23.5	25	12	∞	41	.89	33	3	1759	175	12	1	A	3-1,450	A-8	HIN 9CMR S3 HUM ——— — DON 9CFB V2 FEL	V2		4-16
4-17	149	HIN-CLO	-5	-6	34.5	34	6	53	44	.67	0	0	127	31	9	0	A	———	—	CLO 9CVN V2 MRE ——— — HUM 9AEF S3 HIN	V2		4-17
4-18	153	HIN-CLO	4	3	34	33.5	5	47	50	.55	1	2	498	116	16	0	A	3-2,209	A-2	CLO 9CVN V2 MRE 9AEG S3 HIN	V2		4-18
4-19	151	HIN-CLO	-3	-4	35.5	33	10	51	42	.84	0	7	298	57	7	1	AC	3-2,158	A-1	CLO 9CVN V2 MRE 9AEA V2 HIN	V2		4-19
4-20	131	HIN-CLO	1	1	26	27	13	32	40	2.70	10	62	1816	1389	286	6	A	3-1,401	A-7	HIN 9AEA V2 MRE 9CEP V2 FEL	V2		4-20
4-21	155	HIN-CLO	2	1	39	35	7	55	50	.36	0	1	12	7	3	1	A	3-2,258	A-3	CLO 9CUY S3 FEL 9ACF S3 HIN	V2		4-21

Table C-5. Trans - Atlantic Calls (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	RTP	NATO 1	NATO 2	INTELSAT	TAT I	TAT III	TAT IV	TAT V	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
5-1	222	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2155	6.39E-3	0	100	2	0	0	0	0	0	0	6.39E-3	9.83E-3	8.79E-3	8.21E-3	4-4	18	5-1
5-2	223	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2218	2.04E-1	-	-	-	-	-	-	-	-	-	2.04E-1	-	-	2.53E-1	1-1	13	5-2
5-3	210	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1751	4.46E-3	0	100	2	0	0	0	0	0	0	4.46E-3	4.81E-3	6.46E-3	[illegible]	4-4	22	5-3
5-4	211	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1805	1.92E-1	-	-	-	-	-	-	-	-	-	1.92E-1	-	-	2.22E-1	1-1	14	5-4
5-5	186	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1537	4.02E-3	1.75E-5	99	0	2	0	0	0	0	0	4.02E-3	4.08E-3	3.95E-3	4.57E-3	5-5	18	5-5
5-6	187	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1601	2.37E-1	-	-	-	-	-	-	-	-	-	2.37E-1	-	-	-	1-1	12	5-6
5-7	188	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1625	2.40E-2	0	100	0	2	0	0	0	[illegible]	0	2.40E-2	1.87E-2	2.02E-2	3.24E-2	5-5	17	5-7
5-8	189	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1648	1.87E-1	-	-	-	-	-	-	-	-	-	1.87E-1	-	-	-	1-1	10	5-8
5-9	248	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2137	4.87E-3	1.12E-5	98	0	2	0	0	0	0	0	4.87E-3	5.84E-3	8.47E-3	1.03E-2	4-4	21	5-9
5-10	249	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2158	2.44E-1	-	-	-	-	-	-	-	-	-	2.44E-1	-	-	2.51E-1	1-1	11	5-10
5-11	224	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2220	2.62E-3	0	100	0	2	0	0	0	0	0	2.62E-3	3.69E-3	4.72E-3	4.42E-3	4-4	19	5-11
5-12	225	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2240	2.66E-1	-	-	-	-	-	-	-	-	-	2.66E-1	-	-	No Sync	2-2	10	5-12
5-13	244	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2020	1.30E-2	0	100	0	2	0	0	0	0	0	1.30E-2	1.45E-2	1.68E-2	1.85E-2	4-4	18	5-13
5-14	245	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2040	2.44E-1	-	-	-	-	-	-	-	-	-	2.44E-1	-	-	2.76E-1	1-1	11	5-14
5-15	214	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1950	2.37E-2	5.00E-6	98	0	0	0	0	2	0	0	2.37E-2	2.81E-2	3.10E-2	2.60E-2	4-4	17	5-15
5-16	215	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2015	1.51E-1	-	-	-	-	-	-	-	-	-	1.51E-1	-	-	1.76E-1	1-1	13	5-16
5-17	242	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1944	1.61E-2	1.37E-5	94	0	0	0	0	2	0	0	1.61E-2	1.76E-2	1.78E-2	1.82E-2	4-4	19	5-17
5-18	243	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2005	1.02E-1	-	-	-	-	-	-	-	-	-	1.02E-1	-	-	1.11E-1	1-1	15	5-18
5-19	220	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2123	1.33E-2	1.00E-5	95	0	0	0	0	2	0	0	1.33E-2	1.66E-2	1.53E-2	1.61E-2	4-4	19	5-19
5-20	221	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2141	1.34E-1	-	-	-	-	-	-	-	-	-	1.34E-1	-	-	1.65E-1	1-1	15	5-20
5-21	204	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1551	3.39E-3	8.75E-6	99	0	0	0	0	2	0	0	3.39E-3	3.80E-3	4.71E-3	4.66E-3	4-4	22	5-21
5-22	205	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1610	8.99R-2	-	-	-	-	-	-	-	-	-	8.99E-2	-	-	1.01E-1	1-1	16.5	5-22
5-23	236	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1650	1.14E-2	1.25E-6	96	0	0	0	0	2	0	0	1.14E-2	1.28E-2	1.37E-2	1.28E-2	4-4	20	5-23
5-24	237	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1707	9.34E-2	-	-	-	-	-	-	-	-	-	9.34E-2	-	-	1.36E-1	1-1	16	5-24
5-25	212	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1930	1.82E-3	0	100	0	0	0	0	2	0	0	1.82E-3	2.05E-3	2.83E-3	2.68E-3	4-4	22	5-25
5-26	213	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1950	3.71E-2	-	-	-	-	-	-	-	-	-	3.71E-2	-	-	3.99E-2	1-1	17	5-26

Table C-5. Trans - Atlantic Calls (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	NATO 1	NATO 2	INTELSAT	TAT I	TAT III	TAT IV	TAT V	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
5-27	216	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2030	1.34E-2	7.50E-6	97	0	0	0	0	2	0	0	1.34E-2	1.61E-2	1.69E-2	1.58E-2	4-4	17	5-27
5-28	217	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2045	1.29E-1	-	-	-	-	-	-	-	-	-	1.29E-1	-	-	2.31E-1	1-1	14.5	5-28
5-29	202	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1520	2.48E-3	0	100	0	0	0	0	2	0	0	2.48E-3	1.17E-3	2.08E-3	2.81E-3	4-4	22	5-29
5-30	203	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1537	7.49E-2	-	-	-	-	-	-	-	-	-	7.49E-2	-	-	1.32E-1	1-1	17	5-30
5-31	229	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1424	2.87E-4	0	100	0	0	0	0	1	0	0	2.87E-4	1.81E-4	5.75E-4	6.64E-4	4-4	22	5-31
5-32	230	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1440	3.67E-2	-	-	0	0	0	0	2	0	0	3.67E-2	-	-	6.30E-2	1-1	16.5	5-32
5-33	190	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1710	3.23E-4	8.37E-5	89	0	0	0	0	0	0	1	3.23E-4	6.54E-4	9.08E-4	9.94E-4	4-4	25	5-33
5-34	191	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1735	3.22E-2	-	-	0	0	0	0	0	0	2	3.22E-2	-	-	3.35E-2	1-1	18	5-34
5-35	227	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1401	3.35E-4	0	100	0	0	0	0	0	0	1	3.35E-4	7.32E-4	1.31E-3	1.75E-3	4-4	23	5-35
5-36	228	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1417	4.13E-2	-	-	0	0	0	0	0	0	2	4.13E-2	-	-	-	1-1	17	5-36
5-37	192	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1755	7.10E-4	0	100	0	0	0	0	0	0	1	7.10E-4	2.94E-4	7.85E-4	7.98E-4	4-4	24	5-37
5-38	193	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1813	3.82E-2	-	-	0	0	0	0	0	0	2	3.82E-2	-	-	4.37E-2	1-1	16	5-38
5-39	200	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1437	2.94E-3	4.50E-5	91	0	0	0	0	0	0	1	2.94E-3	1.36E-3	1.40E-3	1.49E-3	4-4	23	5-39
5-40	201	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1449	4.08E-2	-	-	0	0	0	0	0	0	2	4.08E-2	-	-	5.07E-2	1-1	16.5	5-40
5-41	194	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1918	5.22E-3	1.75E-3	97	0	0	0	1	0	0	0	5.22E-3	4.37E-3	3.65E-3	2.45E-3	4-4	19	5-41
5-42	195	Ft. Dietrich, Md - Hillingdon, Eng	11/30	1935	4.80E-2	-	-	0	0	0	2	0	0	0	4.80E-2	-	-	6.73E-2	1-1	15	5-42
5-43	232	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1541	1.06E-2	8.75E-6	96	0	0	0	0	0	1	0	1.06E-2	1.32E-2	1.27E-2	1.20E-2	4-4	20	5-43
5-44	233	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1552	1.11E-1	-	-	0	0	0	0	0	2	0	1.11E-1	-	-	1.34E-1	1-1	15	5-44
5-45	240	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1906	3.41E-2	6.25E-6	97	0	0	1	0	0	0	0	3.41E-2	3.63E-2	3.63E-2	3.94E-2	4-4	17.5	5-45
5-46	241	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1924	1.40E-1	-	-	0	0	2	0	0	0	0	1.40E-1	-	-	1.93E-1	1-1	14	5-46
5-47	246	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2045	7.75E-3	2.72E-4	[illegible]	0	0	1	0	0	0	0	7.75E-3	8.86E-3	9.33E-3	7.96E-2	4-4	20	5-47
5-48	247	Ft. Dietrich, Md - Hillingdon, Eng	12/2	2110	1.84E-1	-	-	0	0	2	0	0	0	0	1.84E-1	-	-	2.04E-1	1-1	11	5-48
5-49	238	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1718	4.05E-3	0	100	0	0	1	0	0	0	0	4.05E-3	3.23E-3	2.71E-3	2.51E-3	4-4	20	5-49
5-50	239	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1737	5.28E-2	-	-	0	0	2	0	0	0	0	5.28E-2	-	-	5.71E-2	1-1	17	5-50
5-51	231	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1453	1.65E-3	-	-	0	0	1	0	0	0	0	1.65E-3	2.05E-3	2.45E-3	2.23E-3	2-2	21	5-51
5-52	234	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1625	5.92E-3	0	100	0	0	1	0	0	0	0	5.92E-3	6.42E-3	7.16E-3	6.72E-3	4-4	19	5-52

Table C-5. Trans-Atlantic Calls (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER R-110	BTP	NATO 1	NATO 2	INTELSAT	TAT I	TAT III	TAT IV	TAT V	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
5-53	235	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1640	8.50E-2	-	-	0	0	2	0	0	0	0	8.50E-2	-	-	1.05E-1	1-1	15	5-53
5-54	206	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1646	1.12E-3	0	100	0	0	1	0	0	0	0	1.12E-3	1.81E-3	2.39E-3	1.86E-3	4-4	21	5-54
5-55	207	Ft. Dietrich, Md - Hillingdon, Eng	12/1	1705	3.48E-2	-	-	0	0	2	0	0	0	0	3.48E-2	-	-	5.27E-2	1-1	13	5-55
5-56	238	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1721	6.54E-4	0	100	0	0	1	0	0	0	0	6.54E-4	3.01E-3	1.02E-3	1.12E-3	4-4	23	5-56
5-57	239	Ft. Dietrich, Md - Hillingdon, Eng	12/2	1743	3.39E-2	-	-	0	0	2	0	0	0	0	3.39E-2	-	-	2.87E-2	1-1	18.5	5-57
5-58	198	Ft. Dietrich, Md - Hillingdon, Eng	11/30	2133	4.24E-4	0	100	0	0	1	0	0	0	0	4.24E-4	2.32E-4	4.12E-4	5.70E-4	4-4	20	5-58
5-59	199	Ft. Dietrich, Md - Hillingdon, Eng	11/30	2150	1.97E-2	-	-	0	0	2	0	0	0	0	1.97E-2	-	-	2.01E-2	1-1	18	5-59
5-60	196	Ft. Dietrich, Md - Hillingdon, Eng	11/30	2030	1.73E-3	0	100	0	0	1	0	0	0	0	1.73E-3	2.14E-3	3.05E-3	2.78E-3	4-4	22	5-60
5-61	197	Ft. Dietrich, Md - Hillingdon, Eng	11/30	2044	4.25E-2	-	-	0	0	2	0	0	0	0	4.25E-2	-	-	4.62E-2	2-2	17	5-61
5-62	218	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2056	8.72E-4	0	100	0	0	1	0	0	0	0	8.72E-4	9.58E-4	1.38E-3	1.42E-3	4-4	22	5-62
5-63	219	Ft. Dietrich, Md - Hillingdon, Eng	12/1	2115	8.25E-2	-	-	0	0	2	0	0	0	0	8.25E-2	-	-	1.45E-1	1-1	14	5-63

Table C-5. Trans - Atlantic Calls (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
5-1	222	FTD-HIN	3	-2	38	30	9	44	35	1.88	0	0	1173	3	0	0	A	5-1,058	A-4	FTD — POT B440 V2 HIN	V2		5-1
5-2	223	Looped	3	1	33.5	28	11	38	29	3.76	-	-	-	-	-	-	A	—	-	Same as 222	V1		5-2
5-3	210	FTD-HIN	1	1	37	29.5	5	38		2.17	0	0	1467	3	0	0	AD	4-2,397	A-8	FTD — CED B486 V2 HIN	V2		5-3
5-4	211	Looped	-2	-3	33	27	6	36	27	4.74	-	-	-	-	-	-	A	—	-	Same as 210	V1		5-4
5-5	186	FTD-HIN	2	1	36	34	7	40	35	2.04	-	-	-	-	-	-	AD	4-2,052	A-5,A-6	FTD — POT B242 V2 HIN	V2	28	5-5
5-6	187	Looped	1	0	27	29	10	37	29	3.82	-	-	-	-	-	-	A	—	-	Same as 186	V1	29	5-6
5-7	188	FTD-HIN	1	-2	34.5	33	8	44	36	1.71	0	0	47	16	8	1	AD	4-2,099	A-7	FTD — POT B243 V2 HIN	V1	30	5-7
5-8	189	Looped	-2	-4	26	30	10	38	30	3.40	-	-	-	-	-	-	A	—	-	Same as 188	V1		5-8
5-9	248	FTD-HIN	-1	-3	37	35	5	41	35	1.99	0	0	14	10	8	0	A	5-1,373	A-6	FTD — POT B243 V2 HIN	V2		5-9
5-10	249	Looped	-4	-4	33	-	8	39	28	4.14	-	-	-	-	-	-	A	—	-	Same as 249	V1		5-10
5-11	224	FTD-HIN	0	-1	33	32.5	8	42	36	1.77	0	0	157	29	9	0	AD	5-1,071	A-5	FTD — CED B246 V2 HIN	V2	31	5-11
5-12	225	Looped	0	-2	28	30	10	38	29	3.76	-	-	-	-	-	-	AD	—	-	Same as 224	V1		5-12
5-13	244	FTD-HIN	1	1	33	28	7	31	32	3.77	0	0	1692	74	32	0	A	5-1,315	A-4	FTD — CED B247 V2 HIN	V2		5-13
5-14	245	Looped	-2	-2	28	27	8	35	26	5.32	-	-	-	-	-	-	A		-	Same as 244	V2		5-14
5-15	214	FTD-HIN	-1	1	36	24	13	38	27	4.64	0	0	1874	1965	214	0	A	4-2,463	A-10	FTD — POT B430 S3 HIN	S1		5-15
5-16	215	Looped	-3	-1	27	22	17	29	22	8.70	-	-	-	-	-	-	A	—	-	Same as 214	V1		5-16
5-17	242	FTD-HIN	1	2	33.5	35	10	34	33	2.99	0	0	1839	1892	21	0	A	5-1,289	A-3	FTD — POT B430 S3 HIN	S1		5-17
5-18	243	Looped	-1	0	28	21	14	41	24	6.37	-	-	-	-	-	-	A	—	-	Same as 242	V2		5-18
5-19	220	FTD-HIN	2	1	30.5	25	12	[illegible]	34	1.99	0	0	1864	1685	1	0	A	5-1,038	A-3	FTD — POT B432 S3 HIN	V2		5-19
5-20	221	Looped	-2	-1	25.5	23	13	32	26	5.61	-	-	-	-	-	-	A	—	-	Same as 220	V1		5-20
5-21	204	FTD-HIN	2	2	32	32	5	44	31	2.89	0	4	270	0	0	0	A	4-2,306	A-5	FTD — CED B484 S3 HIN	S1		5-21
5-22	205	Looped	0	-1	23	27	8	43	26	5.06	-	-	-	-	-	-	A	—	-	Same as 204	V2		5-22
5-23	236	FTD-HIN	-5	-5	32.5	25	10	37	37	1.99	0	0	1864	1735	15	0	A	5-1,210	A-10	FTD — CED B475 S3 HIN	S1		5-23
5-24	237	Looped	-4	-5	26.5	25	13	38	28	4.17	-	-	-	-	-	-	A	—	-	Same as 205	V2		5-24
5-25	212	FTD-HIN	4	3	28	29.5	6	40	35	2.04	0	0	1394	7	0	0	A	4-2,431	A-9	FTD — CED B481 S3 HIN	S1		5-25
5-26	213	Looped	5	6	23.5	25	10	36	26.5	4.99	-	-	-	-	-	-	A	—	-	Same as 212	S1		5-26

Table C-5. Trans - Atlantic Calls (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
5-27	216	FTD-HIN	4	3	30	25	12	∞	38	1.26	0	0	1848	1743	3	0	A	5-1,000	A-1	FTD —— CED B478 S3 HIN	V2		5-27
5-28	217	Looped	5	6	25	22	17	∞	29	3.55	-	-	-	-	-	-	A	——	-	Same as 216	V2		5-28
5-29	202	FTD-HIN	1	1	36	33	5	43	31	2.91	0	0	9	1	1	0	A	4-2,280	A-4	FTD —— CED B482 S3 HIN	S1		5-29
5-30	203	Looped	-2	-	26	30	7	47	25	5.64	-	-	-	-	-	-	A	——	-	Same as 202	V2		5-30
5-31	229	FTD-HIN	1	0	36	35	5	42	34	2.13	0	0	0	0	0	0	A	5-1,137	A-7	FTD —— CED B482 S3 HIN	S1		5-31
5-32	230	Looped	-2	-3	36	39	7	35	27	4.81	-	-	-	-	-	-	A	——	-	Same as 229	V2		5-32
5-33	190	FTD-HIN	2	2	35	34	4	42	35	1.95	0	0	402	286	112	0	AD	4-2,135	A-8	FTD —— CED B485 S3 HIN	S1		5-33
5-34	191	Looped	-2	-2	29	30	7	35	26	5.32	-	-	-	-	-	-	A	——	-	Same as 190	V2		5-34
5-35	227	FTD-HIN	2	2	36	33	4	41	33	2.41	0	0	80	0	0	0	A	5-1,116	A-6	FTD —— CED B485 S3 HIN	S1		5-35
5-36	228	Looped	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	——	-	Same as 227	-		5-36
5-37	192	FTD-HIN	2	2	36.5	33.5	6	40	35	2.04	0	0	20	2	1	0	A	4-2,154	A-9	FTD —— POT B439 S3 HIN	V2	32	5-37
5-38	193	Looped	-1	-2	28	28	8	30	27	5.47	-	-	-	-	-	-	A	——	-	Same as 193	V2		5-38
5-39	200	FTD-HIN	2	0	36	33	6	∞	35	1.77	0	4	18	0	0	0	A	4-2,257	A-3	FTD —— POT B439 S3 HIN	V2		5-39
5-40	201	Looped	-2	-3	28	29	10	34	28	4.45	-	-	-	-	-	-	A	——	-	Same as 200	V2		5-40
5-41	194	FTD-HIN	-5	-5	37.5	32	6	35	33	2.85	0	0	411	133	28	0	A	4-2,176	A-10	FTD —— POT B438 S3 HIN	S1		5-41
5-42	195	Looped	-7	-5	26	24	11	34	25	5.97	-	-	-	-	-	-	A	——	-	Same as 19[illegible]	V2		5-42
5-43	232	FTD-HIN	4	4	33.5	25	10	42	40	1.28	2	42	1830	1805	21	31	A	5-1,159	A-8	FTD —— POT B434 S3 HIN	S1		5-43
5-44	233	Looped	3	3	28	22	15	32	25	6.15	-	-	-	-	-	-	A	——	-	Same as 232	V2		5-44
5-45	240	FTD-HIN	0	0	32	25	8	28	31	4.88	0	0	1880	1856	0	0	AC	5-1,260	A-2	FTD —— POT B431 S3 HIN	V2		5-45
5-46	241	Looped	0	0	30	23	11	29	24	7.28	-	-	-	-	-	-	A	——	-	Same as 240	V1		5-46
5-47	246	FTD-HIN	1	0	36	30	7	29	32	4.35	0	0	1644	14	3	0	A	5-1,343	A-5	FTD —— CED B477 S3 HIN	S3		5-47
5-48	247	Looped	-4	-4	32.5	24	10	27	24	7.73	-	-	-	-	-	-	A	——	-	Same as 246	V2		5-48
5-49	208	FTD-HIN	4	4	31	29.5	8	36	32	3.53	0	0	1845	1245	1	1	A	4-2,363	A-7	FTD —— POT B436 S3 HIN	V2	33	5-49
5-50	209	Looped	-1	-2	27	27	9	38	27	4.64	-	-	-	-	-	-	A	——	-	Same as 208	V1		5-50
5-51	231	FTD-HIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	——	-	FTD —— POT B436 S3 HIN	-		5-51
5-52	234	FTD-HIN	-2	-2	31	27	13	42	30	3.26	0	0	1803	151	2	0	A	5-1,185	A-9	FTD —— POT B437 S3 HIN	S1		5-52

Table C-5. Trans - Atlantic Calls (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
5-53	235	Looped	-3	-1	28	26	18	39	26	5.13	-	-	-	-	-	-	A	—	-	Same as 234	V2		5-53
5-54	206	FTD-HIN	1	1	33	30	12	40	34	2.23	0	461	1366	159	68	0	AB	4-2,333	A-6	FTD — POT B435 S3 HIN	V2		5-54
5-55	207	Looped	-2	-3	29	27	29	39	27	4.61	-	-	-	-	-	-	AB	—	-	Same as 206	V2		5-55
5-56	238	FTD-HIN	4	4	31	29	6	45	36	1.68	0	0	1444	7	0	0	A	5-1,236	A-1	FTD — CED B476 S3 HIN	V2		5-56
5-57	239	Looped	3	4	27.5	25.5	8	33	27	4.99	-	-	-	-	-	-	A	—	-	Same as 238	V2		5-57
5-58	198	FTD-HIN	5	5	34	32	5	40	35	2.04	0	0	18	0	0	0	A	4-2,225	A-2	FTD — CED B480 S3 HIN	S1		5-58
5-59	199	Looped	3	3	28	29	4	43	25	5.67	-	-	-	-	-	-	A	—	-	Same as 198	V2		5-59
5-60	196	FTD-HIN	4	3	32	32	6	35	32	3.07	0	0	35	0	0	0	AD	4-2,196	A-1	FTD — CED B483 S3 HIN	V2		5-60
5-61	197	Looped	5	5	26	29	7	30	27	5.47	-	-	-	-	-	-	A	—	-	Same as 196	V2		5-61
5-62	218	FTD-HIN	2	2	32.5	30.5	6	43	35	1.91	0	0	669	1	0	0	A	5-1,019	A-2	FTD — CED B479 S3 HIN	S1		5-62
5-63	219	Looped	2	2	29	28	7	30	27	5.47	-	-	-	-	-	-	A	—	-	Same as 218	V2		5-63

Table C-6. Trans-Pacific Calls (Sheet 1)

Table *	Call *	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	DSCS	INTELSAT I	INTELSAT II	HAWAII I	HAWAII II	HAWAII III	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table *
6-1	278	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1245	1.24E-4	3.50E-5	94	0	0	0	0	0	1	1.24E-4	5.30E-3	5.62E-3	5.94E-3	4-4	24	6-1
6-2	279	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1307	1.94E-1	-	-	0	0	0	0	0	2	1.94E-1	-	-	2.22E-1	1-1	15	6-2
6-3	285	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1451	1.19E-4	0	100	0	0	0	0	0	1	1.19E-4	1.54E-4	2.91E-4	3.78E-4	4-4	25	6-3
6-4	286	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1512	8.76E-3	-	-	0	0	0	0	0	2	8.76E-3	-	-	1.01E-2	1-1	21	6-4
6-5	287	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1533	2.11E-4	0	100	0	0	0	0	0	1	2.11E-4	3.58E-4	5.36E-4	5.69E-4	4-4	23	6-5
6-6	288	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1555	3.02E-2	-	-	0	0	0	0	0	2	3.02E-2	-	-	2.87E-2	1-1	18	6-6
6-7	302	Stockton, Calif. - Pearl Harbor, Hawii	12/15	1355	1.68E-3	0	100	0	0	0	0	0	1	1.68E-3	2.59E-3	2.83E-2	3.61E-3	4-4	24	6-7
6-8	303	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1412	6.29E-2	-	-	0	0	0	0	0	2	6.29E-2	-	-	8.17E-2	1-1	18	6-8
6-9	326	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1520	5.12E-5	0	100	0	0	0	0	0	1	5.12E-5	5.12E-5	3.23E-4	3.36E-4	4-4	25	6-9
6-10	327	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1535	1.33E-2	-	-	0	0	0	0	0	2	1.33E-2	-	-	1.58E-2	1-1	20	6-10
6-11	319	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1319	8.90E-4	0	100	0	0	0	0	0	1	8.90 E-4	1.05E-3	1.94E-3	1.50E-3	4-4	24	6-11
6-12	320	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1335	5.74E-2	-	-	0	0	0	0	0	2	5.74E-2	-	-	6.94E-2	1-1	17	6-12
6-13	323	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1417	2.66E-4	0	100	0	0	0	0	0	1	2.66E-4	3.72E-4	7.96E-4	7.20E-4	4-4	24	6-13
6-14	324	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1440	1.05E-2	-	-	0	0	0	0	0	2	1.05E-2	-	-	1.07E-2	1-1	20	6-14
6-15	325	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1448	4.00E-5	0	100	0	0	0		Cable		4.00E-5	1.21E-4	1.66E-4	2.15E-4	3-3	23	6-15
6-16	289	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1604	1.87E-5	0	100	0	0	0	0	0	1	1.87E-5	7.60E-6	1.19E-4	1.16E-4	4-4	26	6-16
6-17	290	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1623	4.47E-3	-	-	0	0	0	0	0	2	4.47E-3	-	-	4.38E-3	1-1	22	6-17
6-18	318A	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1310	3.20E-4	-	-	0	0	0		Cable		3.20E-4	-	-	-	1-1	26	6-18
6-19	309	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1618	6.62E-5	0	100	0	0	0	0	0	1	6.62E-5	2.75E-5	2.37E-5	4.87E-5	4-4	26	6-19
6-20	310	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1637	5.39E-3	-	-	0	0	0	0	0	2	5.39E-3	-	-	5.61E-3	1-1	22	6-20
5-21	321	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1348	9.12E-5	0	100	0	0	0	0	1	0	3.12E-5	4.00E-5	9.87E-5	1.16E-4	4-4	26	6-21
6-22	322	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1407	9.38E-3	-	-	0	0	0	0	2	0	9.38E-3	-	-	9.47E-3	1-1	21	6-22
6-23	330	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1628	5.00E-6	0	100	0	0	0	1	0	0	5.00E-6	6.37E-5	1.12E-4	9.12E-5	4-4	26	6-23
6-24	331	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1640	4.97E-3	-	-	0	0	0	2	0	0	4.97E-3	-	-	4.82E-3	1-1	21	6-24
6-25	335	Stockton, Calif. - Pearl Harbor, Hawaii	12/17	1255	3.00E-5	0	100	0	0	0	1	0	0	3.00E-5	5.62E-5	1.87E-4	1.39E-4	4-4	25	6-25
6-26	336	Stockton, Calif. - Pearl Harbor, Hawaii	12/17	1315	8.81E-3	-	-	0	0	0	2	0	0	8.81E-3	-	-	-	1-1	20	6-26

Table C-6. Trans-Pacific Calls (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	DSCS	INTELSAT I	INTELSAT II	HAWAII I	HAWAII II	HAWAII III	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
6-27	298	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1249	1.74E-4	0	100	0	0	0			Cable	1.74E-4	4.19E-4	7.03E-4	7.59E-4	4-4	24	6-27
6-28	299	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1314	1.45E-2	-	-	0	0	0			Cable	1.45E-2	-	-	1.76E-2	1-1	20	6-28
6-29	303	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1606	5.24E-4	-	-	0	0	0			Cable	5.24E-4	6.09E-4	-	-	2-2	23	6-29
6-30	304	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1430	5.25E-5	7.25E-5	95	0	0	1	0	0	0	5.25E-5	9.37E-5	2.15E-4	9.87E-4	4-4	24	6-30
6-31	305	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1458	5.04E-3	-	-	0	0	2	0	0	0	5.04E-3	-	-	4.56E-3	1-1	17	6-31
6-32	317	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1240	6.37E-5	5.00E-6	98	0	0	1	0	0	0	6.37E-5	1.51E-4	3.39E-4	6.00E-5	4-4	22	6-32
6-33	318	Stockton, Calif. - Pearl Harbor, Hawaii	12/16	1300	3.60E-3	-	-	0	0	2	0	0	0	3.60E-3	-	-	3.66E-3	1-1	20	6-33
6-34	267	Stockton, Calif. - Pearl Harbor, Hawaii	12/13	1532	2.25E-5	6.25E-6	99	0	0	1	0	0	0	2.25E-5	9.00E-5	8.50E-5	2.89E-4	4-4	23	6-34
6-35	268	Stockton, Calif. - Pearl Harbor, Hawaii	12/13	1600	7.37E-3	-	-	0	0	2	0	0	0	4.38E-3	-	-	4.06E-3	1-1	18	6-35
6-36	280	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1319	5.67E-3	0	100	0	0	1	0	0	0	5.67E-3	5.60E-3	5.58E-3	6.45E-3	4-4	20	6-36
6-37	300	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1324	1.29E-4	1.75E-5	95	0	0	1	0	0	0	1.29E-4	9.38E-5	9.84E-5	1.15E-4	4-4	22	6-37
6-38	301	Stockton, Calif. - Pearl Harbor, Hawaii	12/15	1344	3.78E-3	-	-	0	0	2	0	0	0	3.78E-3	-	-	3.83E-3	1-1	18	6-38
6-39	282	Stockton, Calif. - Pearl Harbor, Hawaii	12/14	1400	1.31E-2	1.71E-4	51	0	0	1	0	0	0	6.46E-3	7.59E-3	7.55E-3	[illegible]	4-4	20	6-39
6-40	337	Stockton, Calif. - Pearl Harbor, Hawaii	12/17	1317	5.26E-4	2.50E-6	99	0	1	0	0	0	0	5.26E-4	6.84E-4	7.96E-4	1.12E-3	4-4	21	6-40
6-41	338	Stockton, Calif. - Pearl Harbor, Hawaii	12/17	1343	2.01E-2	-	-	0	2	0	0	0	0	2.01E-2	-	-	1.88E-2	1-1	18	6-41
6-42	269	Stockton, Calif. - Pearl Harbor, Hawaii	12/13	1615	2.35E-3	2.50E-6	99	0	1	0	0	0	0	2.35E-3	2.95E-3	1.41E-4	3.12E-3	4-4	22	6-42
6-43	270	Stockton, Calif. - Pearl Harbor, Hawaii	12/13	1640	1.53E-2	-	-	0	2	0	0	0	0	1.53E-2	-	-	1.46E-2	1-1	18	6-43

Table C-6. Trans-Pacific Calls (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD°	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
6-1	278	STK-PHR	-3	-1	34	31	7	39	33	2.50	0	0	242	11	0	1	A	P1-2,093	A-3	STK — SLO B304 S3 WAH KC41 S3 PHR	S1		6-1
6-2	279	Looped	3	3	27	28	9	30	30	4.47	-	-	-	-	-	-	A	—	—	Same as 278	V2		6-2
6-3	285	STK-PHR	-1	1	33	30	7	53	44	.92	0	0	272	2	0	0	A	P1-2,285	A-6	STK — B323 S3 WAH KC41 S3 PHR	V2		6-3
6-4	286	Looped	2	3	29	28	9	38	32	2.81	-	-	-	-	-	-	A	—	—	Same as 285	V2		6-4
6-5	287	STK-PHR	-3	-2	33	30	8	43	43	1.00	0	0	404	2	0	0	A	P1-2,181	A-7	STK — SLO B305 S3 WAH KC41 S3 PHR	S1		6-5
6-6	288	Looped	2	2	28	27	11	41	30	3.28	-	-	-	-	-	-	A	—	—	Same as 287	V2		6-6
6-7	302	STK-PHR	0	-2	29	27	7	37	36	2.12	0	0	1836	385	1	1	A	P1-2,404	A-1	STK — SLO B325 — WAH KC41 S3 PHR	V2		6-7
6-8	303	Looped	4	5	24	24	11	30	29	4.75	-	-	-	-	-	-	A	—	—	Same as 302	V2		6-8
6-9	326	STK-PHR	-2	0	35	31	7	46	43	.87	0	0	113	1	0	0	A	P2-1,184	B-1	STK — SLO B322 S3 WAH KC41 S3 PHR	V2		6-9
6-10	327	Looped	2	3	29	28	8	39	30	3.35	-	-	-	-	-	-	A	—	—	Same as 326	V2		6-10
6-11	319	STK-PHR	-1	1	29	26	7	44	38	1.41	0	0	1769	81	2	0	A	P2-1,119	A-5	STK — SLO B303 S3 WAH KC41 S3 PHR	V2		6-11
6-12	320	Looped	4	4	35	34	11	38	29	3.76	-	-	-	-	-	-	A	—	—	Same as 319	V2		6-12
6-13	323	STK-PHR	-3	-1	31	30	7	46	41	1.02	0	0	1027	0	0	0	A	P2-1,163	B-8	STK — SLO B303 S3 WAH KC41 S3 PHR	V2		6-13
6-14	324	Looped	-1	0	28	28	9	37	32	2.88	-	-	-	-	-	-	A	—	—	Same as 323	V2		6-14
6-15	325	STK-PHR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	—	STK — WAH KC41 S3 PHR	—		6-15
6-16	289	STK-PHR	-1	1	35	33	5	48	43	.81	0	0	12	6	3	1	A	P1-2,205	A-8	STK — LOD B387 S3 WAH KC41 S3 PHR	S1		6-16
6-17	290	Looped	4	4	29	29	6	39	34	2.29	-	-	-	-	-	-	A	—	—	Same as 289	V2		6-17
6-18	318A	STK-PHR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	—	—	STK —	—		6-18
6-19	309	STK-PHR	-3	-1	34	32	5	46	41	1.02	0	0	14	5	4	0	A	P2-1,010	A-3	STK — LOD B390 S3 WAH KC41 S3 PHR	S3		6-19
6-20	310	Looped	1	1	30	31	6	40	33	2.45	-	-	-	-	-	-	A	—	—	Same as 309	V2		6-20
6-21	321	STK-PHR	-2	-1	33	31	6	45	42	.97	0	1	54	0	0	0	A	P2-1,138	A-6	STK — LOD B377 V2 WAH KC41 S3 PHR	V2		6-21
6-22	322	Looped	2	3	28	27	8	37	33	2.65	-	-	-	-	-	-	A	—	—	Same as 321	V2		6-22
6-23	330	STK-PHR	-2	0	34	32	4	42	45	.98	0	1	37	3	2	0	A	P2-1,219	B-2	STK — LOD B360 S3 WAH KC41 S3 PHR	S3		6-23
6-24	331	Looped	1	1	30	28	6	32	35	3.07	-	-	-	-	-	-	A	—	—	Same as 330	S1		6-24
6-25	335	STK-PHR	-4	-5	33	32	5	44	44	.89	0	1	12	0	0	2	A	P2-1,318	B-4	STK — LOD B391 V2 WAH KC41 S3 PHR	S3		6-25
6-26	336	Looped	-	-	-	-	-		-	-	-	-	-	-	-	-	—	—	—	Same as 335	—		6-26

Table C-6. Trans-Pacific Calls (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
6-27	298	STK-PHR	-3	-1	32	30	8	48	39	1.19	0	0	436	0	0	0	A	P1-2,346	A-9	STK ——— WAH KC41 S3 PHR	V2		6-27
6-28	299	Looped	-1	-1	30	29	9	45	32	2.57	-	-	-	-	-	-	A	——	——	Same as 298	V2		6-28
6-29	308	STK-PHR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	——	——	STK ——— WAH KC41 S3 PHR	—		6-29
6-30	304	STK-PHR	-3	-1	35	34	6	46	43	.87	0	0	3	0	0	0	A	P1-2,435	A-2	STK — LOD B368 S3 WAH KC41 S3 PHR	V2		6-30
6-31	305	Looped	-	-	27	28	9	40	34	2.23	-	-	-	-	-	-	A	——	——	Same as 304	V2		6-31
6-32	317	STK-PHR	-1	2	35	32	6	44	43	.95	0	0	457	13	7	1	A	P2-1,098	A-4	STK — LOD B364 S3 WAH KC41 S3 PHR	S1		6-32
6-33	318	Looped	3	5	29	27	9	39	32	2.75	-	-	-	-	-	-	A	——	——	Same as 317	S1		6-33
6-34	267	STK-PHR	-3	-1	34	33	6	44	43	.95	0	0	3	2	1	1	A	P1-1,240	A-1	STK — LOD B369 S3 WAH KC41 S3 PHR	S1	34	6-34
6-35	268	Looped	0	1	29	29	8	38	33	2.57	-	-	-	-	-	-	A	——	——	Same as 267	V2		6-35
6-36	280	STK-PHR	-3	-1	35	33	6	39	41	1.43	0	0	2	1	0	0	A	P1-2,113	A-4	STK — LOD B368 S3 WAH KC41 S3 PHR	V2		6-36
6-37	300	STK-PHR	-2	1	36	33	6	43	43	1.00	0	0	5	0	0	1	A	P1-2,374	A-10	STK — LOD B374 S3 WAH KC41 S3 PHR	S3		6-37
6-38	301	Looped	2	3	28	28	8	42	33	2.37	-	-	-	-	-	-	A	——	——	Same as 300	S1		6-38
6-39	282	STK-PHR	0	0	32	31	10	37	35	2.27	0	0	200	0	0	0	A	P1-2,134	A-5	STK — LOD B316 S3 WAH KC41 S3 PHR	V2		6-39
6-40	337	STK-PHR	-5	-4	34	31	8	43	36	1.74	1	1	54	[illegible]	1	0	A	P2-1,338	B-5	STK — SLO B317 S3 WAH KC41 S3 PHR	S1		6-40
6-41	338	Looped	-1	-1	27	28	12	40	30	3.32	-	-	-	-	-	-	A	——	——	Same as 337	V2		6-41
6-42	269	STK-PHR	-6	-3	35	33	6	33	36	2.74	0	0	4	0	0	0	A	P1-2,000	A-2	STK — SLO B367 S3 WAH KC41 S3 PHR	S1	35	6-42
6-43	270	Looped	-1	0	28	28	8	29	32	4.35	-	-	-	-	-	-	A	——	——	Same as 269	V2		6-43

Table C-7. Pacific IST Loops (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	COMSAT	DSCS	Cable	Tropo	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
		PRIMARY ROUTINGS																
7-1	252	Pearl Harbor, Hawaii - Fuchu, Japan	12/13	0817	2.59E-4	0	100	0	0	2	0	2.59E-4	4.66E-4	3.60E-4	2.50E-4	4-4	26	7-1
7-2	253	Pearl Harbor, Hawaii - Fuchu, Japan	12/13	0848	1.12E-5	0	100	2	0	0	0	1.12E-5	1.62E-5	1.87E-5	3.62E-5	4-4	27	7-2
7-3	262	Pearl Harbor, Hawaii - Fuchu, Japan	12/13	1234	1.27E-4	0	100	2	0	0	0	1.27E-4	1.82E-4	1.82E-4	1.52E-4	4-4	25	7-3
7-4	332	Pearl Harbor, Hawaii - Fuchu, Japan	12/17	0753	2.87E-5	0	100	2	0	0	0	2.87E-5	7.37E-5	3.00E-5	5.00E-5	4-4	26	7-4
7-5	256	Pearl Harbor, Hawaii - Fuchu, Japan	12/13	1359	1.12E-5	0	100	2	0	0	0	1.12E-5	2.27E-4	1.39E-5	2.12E-5	4-4	27	7-5
7-6	250	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/13	1130	4.46E-4	0	100	0	2	0	0	4.46E-4	6.14E-4	7.87E-4	5.31E-4	4-4	25	7-6
7-7	271	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/14	0757	1.22E-4	-	-	0	2	0	0	1.22E-4	2.15E-4	1.46E-3	1.06E-3	2-2	26	7-7
7-8	272	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/14	0806	4.51E-4	0	100	0	2	0	0	4.51E-4	6.22E-4	4.86E-4	4.27E-4	4-4	25	7-8
7-9	314	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/16	1000	2.55E-3	-	-	0	2	0	0	2.55E-3	-	-	-	1-1	22	7-9
7-10	254	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/13	0918	4.31E-4	2.50E-6	99	0	2	0	0	4.31E-4	6.15E-4	7.15E-4	5.01E-4	4-4	25	7-10
7-11	264	Pearl Harbor, Hawaii - Finegeyan, Guam	12/13	1316	5.87E-5	0	100	2	0	0	0	5.87E-5	1.70E-4	4.25E-5	2.25E-5	4-4	28	7-11
7-12	291	Pearl Harbor, Hawaii - Finegeyan, Guam	12/15	0810	1.56E-3	0	100	0	0	2	0	1.56E-3	1.85E-3	1.93E-3	8.22E-4	4-4	22	7-12
7-13	316	Pearl Harbor, Hawaii - Finegeyan, Guam	12/16	1030	7.52E-4	0	100	0	0	2	0	7.52E-4	1.20E-3	9.70E-4	7.96E-4	4-4	24	7-13
7-14	259	Pearl Harbor, Hawaii - Finegeyan, Guam	12/13	1110	1.17E-3	2.50E-6	99	0	2	0	0	1.17E-3	3.54E-4	3.90E-4	3.10E-4	4-4	26	7-14
7-15	255	Pearl Harbor, Hawaii - Finegeyan, Guam	12/13	0942	3.09E-4	5.00E-6	99	0	2	0	0	3.09E-4	3.57E-4	2.67E-4	2.10E-4	4-4	26	7-15
7-16	258	Pearl Harbor, Hawaii - Clark, Philippines	12/13	1045	3.12E-5	0	100	2	0	0	0	3.12E-5	1.35E-4	8.12E-5	9.37E-5	4-4	27	7-16
7-17	265	Pearl Harbor, Hawaii - Clark, Philippines	12/13	1335	3.26E-4	0	100	0	2	0	0	3.26E-4	3.57E-4	4.39E-4	3.29E-4	4-4	25	7-17
7-18	256	Pearl Harbor, Hawaii - Clark, Philippines	12/13	1002	4.99E-4	0	100	0	0	2	0	4.99E-4	1.13E-3	6.02E-4	6.33E-4	4-4	24	7-18
		SECONDARY AND TERNARY ROUTINGS																
7-19	273	Pearl Harbor, Hawaii - Fuchu, Japan	12/14	0835	5.62E-4	0	100	0	2	0	2	5.62E-4	5.70E-4	5.32E-4	5.42E-4	4-4	25	7-19
7-20	277	Pearl Harbor, Hawaii - Fuchu, Japan	12/14	1110	3.01E-3	1.77E-3	95	0	2	0	2	3.81E-3	6.67E-3	1.58E-2	5.52E-3	3-3	23	7-20
7-21	274	Pearl Harbor, Hawaii - Fuchu, Japan	12/14	0958	4.88E-3	0	100	0	2	2	0	4.88E-3	4.06E-3	4.41E-3	4.44E-3	3-3	22	7-21
7-22	263	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/13	1258	7.03E-3	0	100	0	2	0	2	2.64E-3	2.02E-3	3.20E-3	2.02E-3	3-3	22	7-22
7-23	315	Pearl Harbor, Hawaii - Ft. Buckner, Okinawa	12/16	1005	9.25E-4	2.50E-6	99	2	0	0	2	9.25E-4	1.32E-3	1.53E-3	1.66E-3	4-4	21	7-23
7-24	275	Pearl Harbor, Hawaii - Clark, Philippines	12/14	1008	1.03E-3	2.50E-6	99	0	2	0	2	1.03E-3	1.95E-3	1.80E-3	1.95E-3	4-4	24	7-24
7-25	276	Pearl Harbor, Hawaii - Clark, Philippines	12/14	1037	2.85E-2	4.66E-3	6	0	2	2	0	2.85E-2	2.12E-2	2.51E-2	2.41E-2	5-5	20	7-25

Table C-7. Pacific IST Loops (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
PRIMARY ROUTINGS																							
7-1	252	PHR-FUC	-1	-2	30.5	33	3	44	[illegible]	.63	0	0	3	0	0	0	A	P1-1,000	A-8	PHR KC41 S3 WAH KH55 S3 FUC	S1		7-1
7-2	253	PHR-FUC	-2	-3	34	36	2	48	44	.74	0	0	3	0	0	0	A	P1-1,025	A-9	PHR KC41 S3 WAH KH47 S3 FUC	V2		7-2
7-3	262	PHR-FUC	-2	-3	34	34	3	46	43	.87	0	0	1	0	0	0	A	P1-1,167	B-3	PHR KC41 S3 WAH — — FUC	V2		7-3
7-4	332	PHR-FUC	-1	-2	32	34	3	46	43	.87	0	0	3	1	0	0	A	P2-1,234	B-4	PHR KC41 S3 WAH KH50 S3 FUC	V2		7-4
7-5	266	PHR-FUC	-2	-3	34	36	3	50	44	.71	0	0	1	0	0	0	A	P1-1,221	B-4	PHR KC41 S3 WAH KH47 S3 FUC	V2		7-5
7-6	260	PHR-BUC	-3	-4	32	34	2	46	37	1.50	0	0	3	1	0	0	A	P1-1,145	B-2	PHR KC41 S3 WAH KK85 S3 FTB	V2		7-6
7-7	271	PHR-BUC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	PHR KC41 S3 WAH — — FTB	-		7-7
7-8	272	PHR-BUC	-3	-4	32	34	3	33	37	2.65	0	0	1	0	0	0	A	P1-2,022	B-1	PHR KC41 S3 WAH KK85 S3 FTB	V2		7-8
7-9	314	PHR-BUC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	PHR KC41 S3 WAH — — FTB	-		7-9
7-10	254	PHR-BUC	-3	-4	32	34	2	42	39	1.37	0	0	1	0	0	0	A	P1-1,048	B-1	PHR KC41 S3 WAH KK85 S3 FTB	V2		7-10
7-11	264	PHR-FIN	-2	-4	35	37	2	47	45	.72	0	6	6	1	1	0	A	P1-1,185	B-4	PHR KC41 S3 WAH KE48 S3 FIN	V2		7-11
7-12	291	PHR-FIN	-2	-2	31	31	3	46	39	1.23	0	0	131	0	0	0	A	P1-1,232	B-8	PHR KC41 S3 WAH KE37 S3 FIN	V2		7-12
7-13	316	PHR-FIN	-1	-2	31	32	3	50	38	1.30	0	0	21	1	1	0	A	P2-1,090	C	PHR KC41 S3 WAH KE46 S3 FIN	V2		7-13
7-14	259	PHR-FIN	-2	-2	32	33	3	44	39	1.29	0	0	55	11	3	0	A	P1-1,129	B-9	PHR KC41 S3 WAH KE20 S3 FIN	S1		7-14
7-15	255	PHR-FIN	0	-1	31	33	3	43	40	1.08	0	0	35	16	7	0	A	P1-1,065	B-3	PHR KC41 S3 WAH KE19 S3 FIN	S1		7-15
7-16	258	PHR-CLK	-2	-3	33	35	4	47	43	.84	0	0	0	0	0	0	A	P1-1,109	B-7	PHR KC41 S3 WAH KP15 S3 CLK	V2		7-16
7-17	265	PHR-CLK	-5	-6	32	34	3	47	38	1.34	0	0	2	0	0	0	A	P1-1,202	B-3	PHR KC41 S3 WAH KD75 S3 CLK	S3		7-17
7-18	256	PHR-CLK	-2	-3	30	32	4	43	42	1.06	0	0	650	0	0	0	A	P1-1,083	B-5	PHR KC41 S3 WAH KD96 S3 CLK	S1		7-18
SECONDARY AND TERNARY ROUTINGS																							
7-19	273	PHR-FUC	-2	-1	32	33	4	49	39	1.16	0	0	8	6	1	1	A	P1-2,037	B-1,B-2	PHR KC41 S3 WAH KK83 BUC TROPO FUC	V2		7-19
7-20	277	PHR-FUC	-4	-5	33	34	4	45	36	1.68	-	-	-	-	-	-	-	—	-	PHR KC41 S3 WAH KK81 BUC TROPO FUC	-		7-20
7-21	274	PHR-FUC	-2	0	28	32	5	47	39	1.21	-	-	-	-	-	-	-	—	-	PHR KC41 S3 WAH KE18 FIN CABLE FUC	-		7-21
7-22	263	PHR-BUC	-5	-5	27	33	4	46	34	2.06	-	-	-	-	-	-	-	—	-	PHR KC41 S3 WAH KD73 CLK TROPO BUC	V2		7-22

Table C-7. Pacific IST Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH ·3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
SECONDARY AND TERNARY ROUTINGS (CONTINUED)																							
7-23	315	PHR-BUC	1	-2	33	36	5	45	55	.59	0	2	10	11	2	0	A	P2-1,082	C	PHR KC41 S3 WAH KH48 FUC TROPO BUC	V1		7-23
7-24	275	PHR-CLK	0	-1	28	29	5	46	37	1.49	0	0	1418	9	0	0	A	P1-2,062	B-3	PHR KC41 S3 WAH KK93 BUC TROPO CLK	S1		7-24
7-25	276	PHR-CLK	-2	-2	25	26	15	36	31	3.23	0	1	1835	1735	1305	0	ABC	P1-2,078	B-4	PHR KC41 S3 WAH KE49 FIN CABLE CLK	V2	36	7-25

Table C-8. Pacific Remote Access Loops (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BEP 8-110	BTP	COMSAT	DSCS	Cable	Tropo	M	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tr es-Hits	S/N	Table #
8-1	296	Pearl Harbor - Misawa, Japan (Second 58)	12/15	1055	1.42E-3	0	100	2	0	0	0	4	1.42E-3	1.[illegible]8E-3	1.36E-3	1.27E-3	4-4	23	8-1
8-2	294	Pearl Harbor - Yokusuka, Japan (Second 16)	12/15	1000	1.35E-4	0	100	2	0	0	0	6	1.35E-4	9.53E-5	2.04E-4	1.13E-4	4-4	25	8-2
8-3	31[illegible]	Pearl Harbor - Yokota, Japan (Second 44)	12/16	0818	2.08E-3	0	100	0	0	2	0	2	2.08E-3	2.64E-3	3.32E-3	2.33E-3	4-4	24	8-3
8-4	295	Pearl Harbor - Seoul, Korea (Second 12)	12/15	1025	8.59E-4	0	100	Satellite		0	0	0	8.59E-4	1.42E-3	9.52E-4	4.75E-3	5-5	19	8-4
8-5	29[illegible]	Pearl Harbor - Kadota, Okinawa (Second 13)	12/15	0940	3.86E-2	3.00E-5	96	0	2	0	0	2	3.86E-2	4.84E-2	4.99E-2	8.45E-2	3-3	18	8-5
8-6	312	Pearl Harbor - Kadota, Okinawa (Second 73)	12/16	0913	6.37E-3	0	100	2	0	0	0	0	6.37E-3	6.44E-3	1.07E-2	6.22E-3	4-4	20	8-6
8-7	328	Pearl Harbor - Clark, Philippines (Second 16)	12/16	1350	9.48E-3	0	100	0	0	2	0	0	9.48E-3	1.25E-2	1.26E-2	1.30E-2	4-4	19	8-7
8-8	292	Pearl Harbor - Taipei, Taiwan (Second 17)	12/15	0855	5.47E-2	1.72E-3	52	0	2	0	2	0	4.18E-2	5.31E-2	8.26E-2	7.30E-2	5-5	17	8-8
8-9	313	Pearl Harbor - Taipei, Taiwan (Second 17)	12/16	0928	5.05E-2	2.36E-4	51	0	2	0	2	0	5.05E-2	4.62E-2	7.87E-2	5.41E-2	4-4	16	8-9

Table C-8. Pacific Remote Access Loops (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD	GH -3	PH 20°	59	63	67	DC	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
8-1	296	PHR-MIS	-2	-3	32	34	3	46	39	1.23	0	0	3	0	0	0	A	P1-2,302	B-10	PHR KC41 S3 WAH RH48 S3 FUC —— MIS (58)	V2		8-1
8-2	294	PHR-YKS	-3	-4	33	35	3	43	40	1.23	0	0	2	1	0	0	A	P1-2,270	C	PHR KC41 S3 WAH KH50 S3 FUC —— YKS (16)	V2		8-2
8-3	311	PHR-YOK	-1	0	29	30	4	46	46	.71	0	0	565	4	2	0	A	P2-1,029	A-10	PHR KC41 S3 WAH KM92 S3 FUC —— YOK (44)	V2		8-3
8-4	295	PHR-SEO	-2	-1	33	29	3	37	35	2.27	0	0	1461	24	8	0	A	P1-2,280	B-8	KC42 S3 WAH KA98 S3 SEO (12)	V1	37	8-4
8-5	293	PHR-KAD	-1	-	29	-	-	-	-	-	-	-	-	-	-	-	-	——	—	PHR KC41 S3 WAH DSCS S3 BUC —— KAD (13)	—		8-5
8-6	312	PHR-KAD	3	3	32	31	5	43	30	3.24	0	0	183	3	1	0	AD	P2-1,048	B-4	PHR KC41 S3 WAH KH49 S3 FUC TROPO FTB —— KAD (73)	V1		8-6
8-7	328	PHR-CLK	-10	-10	27	28	7	46	34	2.06	0	0	1774	239	8	0	A	P2-1,198	B-8	PHR KC41 S3 WAH KD96 S3 CLK —— (16)	V2		8-7
8-8	292	PHR-TAP	-4	-5	30	29	7	33	27	4.99	0	0	1053	19	1	0	ACD	P1-2,251	B-8	PHR KC41 S3 WAH KD75 S3 CLK TROPO TAP (17)	V2		8-8
8-9	313	PHR-TAP	-3	-5	31	30	9	31	30	4.23	2	0	898	4	1	0	ABCD	P2-1,064	B-5	PHR KC41 S3 WAH KD71 S3 CLK TROPO TAP (17)	V1		8-9

Table C-9. CONUS IST Loops (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
9-1	340	Melbourne, Fla #1 - Polk City, Fla	1/11	1002	6.25E-6	0	100	6.25E-6	2.50E-6	2.50E-6	2.50E-6	3-3	29	9-1
9-2	380	Melbourne, Fla #2 - Polk City, Fla	1/17	0840	1.25E-6	0	100	1.25E-6	0	0	1.12E-5	3-3	30	9-2
9-3	341	Melbourne, Fla #1 - Ellisville, Fla	1/11	1038	1.62E-5	0	100	1.62E-5	7.50E-6	0	1.62E-5	3-3	30	9-3
9-4	381	Melbourne, Fla #2 - Ellisville, Fla	1/17	0900	1.55E-4	0	100	1.55E-4	1.60E-4	1.35E-4	1.31E-4	3-3	24	9-4
9-5	342	Melbourne, Fla #1 - Dranesville, Vir	1/11	1104	2.88E-2	0	100	2.88E-2	2.93E-2	2.92E-2	3.09E-2	3-3	21	9-5
9-6	382	Melbourne, Fla #2 - Dranesville, Vir	1/17	0920	1.49E-4	0	100	1.49E-4	1.44E-4	2.15E-4	1.71E-4	3-3	25	9-6
9-7	343	Melbourne, Fla #1 - Brewton, Ala	1/11	1337	4.25E-5	0	100	4.25E-5	8.12E-5	9.25E-5	7.50E-5	3-3	28	9-7
9-8	383	Melbourne, Fla #2 - Brewton, Ala	1/17	0935	2.00E-5	0	100	2.00E-5	4.37E-5	3.00E-5	3.37E-5	3-3	27	9-8
9-9	344	Melbourne, Fla #1 - Jasper, Ala	1/11	1402	5.12E-5	0	100	5.12E-5	1.27E-4	1.64E-4	1.64E-4	3-3	26	9-9
9-10	384	Melbourne, Fla #2 - Jasper, Ala	1/17	0955	8.25E-5	0	100	8.25E-5	6.62E-5	1.11E-4	8.62E-5	3-3	26	9-10
9-11	345	Melbourne, Fla #1 - Chatham, N. Car	1/11	1440	3.41E-4	0	100	3.41E-4	7.25E-4	4.39E-4	5.79E-4	3-3	23	9-11
9-12	385	Melbourne, Fla #2 - Chatham, N. Car	1/17	1010	2.51E-4	2.50E-5	99	2.51E-4	2.54E-4	2.55E-4	2.04E-4	3-3	24	9-12
9-13	346	Melbourne, Fla #1 - Stanfield, N. Car	1/11	1500	1.59E-4	0	100	1.59E-4	5.72E-3	2.46E-4	2.29E-4	3-3	25	9-13
9-14	386	Melbourne, Fla #2 - Stanfield, N. Car	1/17	1030	3.54E-3	0	100	3.54E-3	3.70E-3	3.36E-3	3.86E-3	3-3	20	9-14
9-15	347	Melbourne, Fla #1 - Leesburg, Vir	1/11	1520	1.79E-2	0	100	1.79E-2	1.67E-2	1.94E-2	1.74E-2	3-3	20	9-15
9-16	387	Melbourne, Fla #2 - Leesburg, Vir	1/17	1045	6.28E-3	0	100	6.28E-3	7.66E-3	7.75E-3	6.19E-3	3-3	19	9-16
9-17	348	Melbourne, Fla #1 - Charlottesville, Vir	1/12	0803	4.74E-3	1.25E-6	99	4.74E-3	5.25E-3	4.73E-3	5.03E-3	3-3	21	9-17
9-18	388	Melbourne, Fla #2 - Charlottesville, Vir	1/17	1420	4.94E-3	0	100	4.94E-3	5.57E-3	5.11E-3	5.38E-3	3-3	19	9-18
9-19	349	Melbourne, Fla #1 - Mosely, Vir	1/12	0824	1.65E-4	0	100	1.65E-4	3.16E-4	2.11E-4	2.17E-4	3-3	24	9-19
9-20	389	Melbourne, Fla #2 - Mosely, Vir	1/24	1015	3.08E-3	0	100	3.08E-3	4.35E-3	3.22E-3	3.11E-3	3-3	22	9-20
9-21	350	Melbourne, Fla #1 - Williamstown, Ken	1/12	0845	4.50E-3	0	100	4.50E-3	4.61E-3	4.20E-3	4.90E-3	3-3	22	9-21
9-22	390	Melbourne, Fla #2 - Williamstown, Ken	1/24	1045	4.33E-3	0	100	4.33E-3	6.31E-3	4.13E-3	5.25E-3	3-3	20	9-22
9-23	351	Melbourne, Fla #1 - Hagerstown, Mld	1/12	0905	3.56E-2	4.37E-5	97	3.56E-2	3.95E-2	3.39E-2	4.15E-2	3-3	19	9-23
9-24	391	Melbourne, Fla #2 - Hagerstown, Mld	1/24	1105	3.03E-3	0	100	3.03E-3	4.21E-3	3.21E-3	4.48E-3	3-3	21	9-24
9-25	352	Melbourne, Fla #1 - Toledo Junction, Ohio	1/12	0930	2.99E-3	4.25E-5	92	2.99E-3	3.60E-3	3.29E-3	3.10E-3	3-3	22	9-25
9-26	392	Melbourne, Fla #2 - Toledo Junction, Ohio	1/24	1215	7.40E-4	0	100	7.40E-4	9.85E-4	1.25E-3	9.44E-4	3-3	24	9-26

Table C-9. CONUS IST Loops (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
9-27	353	Melbourne, Fla #1 - Cedar Brook, NJ	1/12	0950	2.71E-3	0	100	2.71E-3	3.31E-3	3.11E-3	2.73E-3	3-3	23	9-27
9-28	393	Melbourne, Fla #2 - Cedar Brook, NJ	1/24	1245	4.52E-3	0	100	4.52E-3	1.11E-2	1.34E-2	5.16E-3	3-3	21	9-28
9-29	354	Melbourne, Fla #1 - Netcong, NJ	1/24	1015	4.83E-3	0	100	4.83E-3	5.63E-3	4.61E-3	3.96E-3	3-3	22	9-29
9-30	394	Melbourne, Fla #2 - Netcong, NJ	1/24	1300	4.08E-3	0	100	4.08E-3	4.67E-3	4.63E-3	5.01E-3	3-3	21	9-30
9-31	357	Melbourne, Fla #1 - Pottstown, Penn	1/12	1207	8.23E-3	0	100	8.23E-3	9.00E-3	8.09E-3	9.18E-3	3-3	20	9-31
9-32	395	Melbourne, Fla #2 - Pottstown, Penn	1/24	1320	3.50E-3	0	100	3.50E-3	3.76E-3	3.33E-3	3.38E-3	3-3	21	9-32
9-33	355	Melbourne, Fla #1 - Chesterfield, Mass	1/12	1230	4.06E-4	0	100	4.06E-4	5.09E-3	5.00E-3	4.82E-3	3-3	21	9-33
9-34	396	Melbourne, Fla #2 - Chesterfield, Mass	1/24	1335	4.72E-3	1.12E-5	95	4.72E-3	6.34E-3	5.59E-3	6.54E-3	3-3	20	9-34
9-35	359	Melbourne, Fla #1 - Littleton, Mass	1/12	1249	5.25E-3	0	100	5.25E-3	6.05E-3	5.56E-3	5.54E-3	3-3	21	9-35
9-36	397	Melbourne, Fla #2 - Littleton, Mass	1/24	1345	5.88E-3	1.25E-6	99	5.88E-3	6.77E-3	6.22E-3	6.08E-3	3-3	20	9-36
9-37	360	Melbourne, Fla #1 - Dover Foxcroft, Mne	1/12	1305	5.98E-3	0	100	5.98E-3	7.15E-3	7.36E-3	7.36E-3	3-3	20	9-37
9-38	393	Melbourne, Fla #2 - Dover Foxcroft, Mne	1/24	1405	4.17E-3	0	100	4.17E-3	4.39E-3	3.82E-3	3.85E-3	3-3	21	9-38
9-39	361	Melbourne, Fla #1 - Stevens Point, Wisc	1/12	1325	7.12E-3	0	100	7.12E-3	7.93E-3	7.77E-3	7.26E-3	3-3	21	9-39
9-40	399	Melbourne, Fla #2 - Stevens Point, Wisc	1/24	1425	4.74E-3	4.12E-5	94	4.74E-3	5.45E-3	5.30E-3	6.74E-3	3-3	21	9-40
9-41	362	Melbourne, Fla #1 - Tully, NY	1/12	1345	4.33E-3	2.50E-6	99	4.33E-3	4.80E-3	4.74E-3	4.54E-3	3-3	21	9-41
9-42	400	Melbourne, Fla #2 - Tully, NY	1/24	1445	5.48E-3	0	100	5.48E-3	6.32E-3	6.08E-3	6.03E-3	3-3	21	9-42
9-43	363	Melbourne, Fla #1 - Wyoming, Minn	1/12	1400	3.79E-2	0	100	3.79E-2	4.08E-2	3.50E-2	4.21E-2	3-3	18	9-43
9-44	401	Melbourne, Fla #2 - Wyoming, Minn	1/24	1500	6.00E-3	0	100	6.00E-3	6.55E-3	5.92E-3	5.44E-3	3-3	20	9-44
9-45	364	Melbourne, Fla #1 - Memphis Junction, Ark	1/12	1415	6.17E-4	0	100	6.17E-4	1.38E-3	9.00E-4	1.76E-3	3-3	22	9-45
9-46	402	Melbourne, Fla #2 - Memphis Junction, Ark	1/24	1520	2.88E-3	0	100	2.88E-3	2.91E-3	2.36E-3	2.65E-3	3-3	22	9-46
9-47	365	Melbourne, Fla #1 - Seguin, Tex	1/12	1435	1.00E-4	0	100	1.00E-4	3.57E-4	1.62E-4	1.30E-4	3-3	25	9-47
9-48	403	Melbourne, Fla #2 - Seguin, Tex	1/24	1540	8.37E-5	0	100	8.37E-5	9.00E-5	4.50E-5	4.37E-5	3-3	26	9-48
9-49	366	Melbourne, Fla #1 - Sweetwater, Tex	1/12	1500	1.62E-5	0	100	1.62E-5	7.37E-5	5.25E-5	5.75E-5	3-3	26	9-49
9-50	404	Melbourne, Fla #2 - Sweetwater, Tex	1/24	1555	3.98E-3	0	100	3.98E-3	4.85E-3	4.27E-3	4.42E-3	3-3	21	9-50
9-51	367	Melbourne, Fla #1 - Socorro, N. Mex	1/12	1520	3.75E-6	0	100	3.75E-6	3.25E-5	9.25E-5	1.12E-5	3-3	23	9-51
9-52	405	Melbourne, Fla #2 - Socorro, N. Mex	1/25	0755	5.97E-4	0	100	5.97E-4	9.87E-4	2.48E-3	2.50E-3	3-3	24	9-52

Table C-9. CONUS IST Loops (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
9-53	368	Melbourne, Fla #1 - Apache Junction, Arz	1/12	1545	2.75E-2	0	100	2.75E-2	3.16E-2	2.91E-2	3.05E-2	3-3	17	9-53
9-54	436	Melbourne, Fla #2 - Apache Junction, Arz	1/25	0820	7.89E-3	0	100	7.89E-3	8.24E-3	8.63E-3	7.70E-3	3-3	20	9-54
9-55	369	Melbourne, Fla #1 - Cheyenne Mountain, Col	1/13	0800	5.24E-3	0	100	5.24E-3	6.24E-3	5.83E-3	5.90E-3	3-3	21	9-55
9-56	407	Melbourne, Fla #2 - Cheyenne Mountain, Col	1/25	0840	4.78E-3	2.37E-5	99	4.78E-3	5.99E-3	5.29E-3	5.47E-3	3-3	21	9-56
9-57	370	Melbourne, Fla #1 - Lamar, Col	1/13	0825	5.02E-3	0	100	5.02E-3	6.07E-3	5.43E-3	5.29E-3	3-3	22	9-57
9-58	408	Melbourne, Fla #2 - Lamar, Col	1/25	0900	8.49E-3	4.87E-5	94	8.49E-3	1.00E-2	9.65E-3	1.19E-2	3-3	20	9-58
9-59	371	Melbourne, Fla #1 - Mounds, Okla	1/13	0915	1.98E-2	0	100	1.98E-2	5.82E-3	5.48E-3	5.16E-3	3-3	23	9-59
9-60	409	Melbourne, Fla #2 - Mounds Okla	1/25	0915	7.19E-3	2.50E-6	99	7.19E-3	8.05E-3	7.28E-3	5.62E-3	3-3	21	9-60
9-61	372	Melbourne, Fla #1 - Lyons, Neb	1/13	0940	6.92E-3	0	100	6.92E-3	7.09E-3	6.18E-3	6.35E-3	3-3	22	9-61
9-62	410	Melbourne, Fla #2 - Lyons, Neb	1/25	0930	9.62E-3	0	100	9.62E-3	1.13E-2	9.43E-3	8.76E-3	3-3	21	9-62
9-63	339	Melbourne, Fla #1 - Helena, Mont	1/11	0910	6.23E-3	0	100	6.23E-3	7.59E-3	1.06E-2	7.82E-3	3-3	18	9-63
9-64	411	Melbourne, Fla #2 - Helena, Mont	1/25	0945	2.91E-2	1.39E-4	94	2.91E-2	3.51E-2	3.38E-2	3.69E-2	3-3	16	9-64
9-65	373	Melbourne, Fla #1 - Lodi, Col	1/13	1010	4.12E-3	0	100	4.12E-3	3.94E-3	5.64E-3	3.40E-3	3-3	22	9-65
9-66	412	Melbourne, Fla #2 - Lodi, Col	1/25	1000	8.28E-3	0	100	8.28E-3	7.87E-3	6.75E-3	5.84E-3	3-3	20	9-66
9-67	374	Melbourne, Fla #1 - Julian, Col	1/13	1030	1.21E-2	5.00E-6	98	1.21E-2	1.37E-2	1.65E-2	1.29E-2	3-3	19	9-67
9-68	413	Melbourne, Fla #2 - Julian, Col	1/25	1025	5.91E-3	1.87E-5	99	5.91E-3	6.70E-3	8.01E-3	7.72E-3	3-3	21	9-68
9-69	375	Melbourne, Fla #1 - Mojave, Col	1/13	1040	6.30E-3	0	100	6.30E-3	6.98E-3	6.28E-3	6.02E-3	3-3	22	9-69
9-70	414	Melbourne, Fla #2 - Mojave, Col	1/25	1035	7.51E-3	0	100	7.51E-3	8.53E-3	7.63E-3	6.77E-3	3-3	21	9-70
9-71	376	Melbourne, Fla #1 - San Luis Obispo, Col	1/13	1112	1.12E-2	8.75E-6	98	1.12E-2	2.77E-3	2.69E-3	2.54E-3	3-3	23	9-71
9-72	415	Melbourne, Fla #2 - San Luis Obispo, Col	1/25	1055	2.16E-2	0	100	2.16E-2	2.34E-2	2.15E-2	2.15E-2	3-3	20	9-72
9-73	377	Melbourne, Fla #1 - Smith Falls, Ontar	1/13	1140	3.17E-2	5.00E-6	99	3.17E-2	3.51E-2	3.19E-2	3.71E-2	3-3	19	9-73
9-74	416	Melbourne, Fla #2 - Smith Falls, Ontar	1/25	1110	2.55E-2	0	100	2.55E-2	3.01E-2	2.72E-2	3.42E-2	3-3	18	9-74
9-75	378	Melbourne, Fla #1 - Sherbrooke, Quebc	1/13	1150	2.74E-2	5.00E-6	98	2.74E-2	3.05E-2	2.79E-2	3.20E-3	3-3	19	9-75
9-76	417	Melbourne, Fla #2 - Sherbrooke, Quebc	1/25	1230	2.02E-2	0	100	2.02E-2	2.94E-2	2.08E-2	2.11E-2	3-3	18	9-76
9-77	379	Melbourne, Fla #1 - Fredericton, Nwbrn	1/13	1220	2.93E-2	3.75E-6	99	2.93E-2	3.34E-2	3.31E-2	3.60E-2	3-3	18	9-77
9-78	418	Melbourne, Fla #2 - Fredericton, Nwbrn	1/25	1245	3.17E-2	2.50E-6	99	3.17E-2	3.56E-2	3.11E-2	3.26E-2	3-3	18	9-78

Table C-9. CONUS IST Loops (Sheet 2)

Table #	Ckt #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Line Character.	Comments	Table #
9-1	340	MEL-POL	1	1	39.5	40.5	2	48	56	.43	0	0	1	0	0	0	V2		9-1
9-2	380	MEL-POL	0	1	45	40	1	37	48	2.03	0	0	5	5	3	0	S1		9-2
9-3	341	MEL-ELL	1	1	40	40	2	47	56	.47	0	0	2	2	0	0	V2		9-3
9-4	381	MEL-ELL	- 1	0	42	28.5	7	39	37	1.80	0	0	165	5	4	0	S1		9-4
9-5	342	MEL-DRA	0	1	37	28	5	30	31	4.23	0	0	992	3	0	0	V1		9-5
9-6	382	MEL-DRA	- 1	1	33	30	5	38	37	1.89	0	0	572	2	1	0	S1		9-6
9-7	343	MEL-BRE	1	1	38	35	2	47	40	1.09	0	0	5	2	0	0	V2		9-7
9-8	383	MEL-BRE	- 1	0	39	34	2	38	39	1.26	0	0	15	6	3	0	S1		9-8
9-9	344	MEL-JAS	1	1	38	35	2	48	40	1.07	0	0	5	1	0	0	V2		9-9
9-10	384	MEL-JAS	1	2	37	31	3	40	38	1.61	0	0	15	5	4	0	S1		9-10
9-11	345	MEL-CHA	1	1	36	39	6	40	40	1.41	0	1	29	1	0	0	V2		9-11
9-12	385	MEL-CHA	- 1	1	35	30	5	39	38	1.69	0	0	1117	2	0	0	S1		9-12
9-13	346	MEL-STN	2	2	37	35	4	41	41	1.26	0	0	12	2	0	0	V2		9-13
9-14	386	MEL-STN	-10	- 9	43	32	8	37	35	2.27	0	0	9	0	0	0	V2		9-14
9-15	347	MEL-LEE	- 1	0	38	29	8	34	30	3.74	0	0	792	2	0	0	V1		9-15
9-16	387	MEL-LEE	- 1	- 1	35.5	28	4	29	49	3.56	0	0	1014	3	1	0	V1		9-16
9-17	348	MEL-CHV	- 1	0	39	31	8	39	30	3.35	0	0	488	2	1	0	V1		9-17
9-18	388	MEL-CHV	- 3	- 2	34.5	30.5	7	38	32	2.81	0	0	598	9	2	0	V2		9-18
9-19	349	MEL-MOS	- 1	1	38	30.5	8	35	36	2.38	0	0	519	1	0	0	V1		9-19
9-20	389	MEL-MOS	1	- 1	38.5	30	5	40	31	2.99	0	0	20	1	0	0	V1		9-20
9-21	350	MEL-WIL	- 2	- 1	37.5	31	6	39	30	3.35	0	403	253	14	0	0	V1		9-21
9-22	390	MEL-WIL	0	0	31	28.5	9	40	38	1.61	1	2	1373	16	5	1	V1		9-22
9-23	351	MEL-HAG	- 2	- 1	35	31	8	38	27	4.64	1	1	920	102	11	0	V1		9-23
9-24	391	MEL-HAG	2	2	30	29	5	40	33	2.45	0	0	1503	15	0	0	V2		9-24
9-25	352	MEL-TOL	3	4	33.5	31	15	42	32	2.63	0	115	78	6	1	0	V1		9-25
9-26	392	MEL-TOL	1	2	34.5	29	4	41	32	2.66	0	0	1219	11	5	0	V2		9-26

Table C-9. CONUS iST Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	P_J^o	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Line Character.	Comments	Table #
9-27	353	MEL-CED	1	2	35.5	31.5	4	34	32	3.21	0	0	26	2	0	0	V1		9-27
9-28	393	MEL-CED	- 1	- 1	35.5	29	8	37	32	2.88	0	0	1316	13	0	0	V2		9-28
9-29	354	MEL-NTG	- 2	- 1	38	29.5	7	39	31	3.03	0	0	156	11	6	0	V1		9-29
9-30	394	MEL-NTG	- 2	- 2	39	31	7	39	31	3.03	0	0	897	3	0	0	V2		9-30
9-31	357	MEL-POT	- 1	1	36	27	10	36	29	3.88	0	2	1805	112	0	0	V1		9-31
9-32	395	MEL-POT	- 2	- 1	34	29	7	40	36	1.87	1	0	1581	16	2	0	V2		9-32
9-33	358	MEL-CHE	- 1	- 1	38	32	8	39	31	3.03	0	0	75	1	0	0	V2		9-33
9-34	396	MEL-CHE	- 1	- 1	35	28	7	41	31	2.95	0	0	1271	12	2	0	V1		9-34
9-35	359	MEL-LIT	- 1	0	37	30	10	40	32	2.70	0	0	886	7	0	0	V1		9-35
9-36	397	MEL-LIT	- 2	- 2	27.5	30	6	42	30	3.26	1	0	1486	11	2	0	V2		9-36
9-37	360	MEL-DOV	- 1	- 1	37	31	10	39	31	3.03	0	0	412	2	0	0	V1		9-37
9-38	398	MEL-DOV	0	- 2	33	30	6	39	31	3.03	1	0	1182	19	1	0	V2		9-38
9-39	361	MEL-STV	3	5	34	29	10	39	31	3.03	0	0	1005	1	0	0	V1		9-39
9-40	399	MEL-STV	0	- 1	31.5	26	7	29	33	4.19	0	0	1830	184	2	0	V1		9-40
9-41	362	MEL-TLY	- 1	0	37	29.5	12	41	31	2.95	0	12	1192	4	0	0	V1		9-41
9-42	400	MEL-TLY	- 3	- 2	34	29	8	38	30	3.40	0	0	1521	15	0	0	V1		9-42
9-43	363	MEL-WYO	- 1	0	35	28	6	28	28	5.63	0	65	1062	1	0	0	V1		9-43
9-44	401	MEL-WYO	- 3	- 2	30	25	8	37	33	2.65	0	1	1831	730	3	0	V1		9-44
9-45	364	MEL-MEM	0	1	38	35	6	41	42	1.19	0	6	1	0	0	0	V1		9-45
9-46	402	MEL-MEM	0	0	35	36.5	6	35	34	2.67	0	0	1642	9	0	0	V2		9-46
9-47	365	MEL-SEG	1	2	36.5	33	5	40	38	1.61	0	0	97	21	2	0	V1		9-47
9-48	403	MEL-SEG	0	1	33	31	4	41	38	1.54	0	0	533	45	7	0	V2		9-48
9-49	366	MEL-SWE	1	2	35	33	6	40	41	1.34	0	2	39	5	0	0	V2		9-49
9-50	404	MEL-SWE	0	1	32	28	7	40	30	3.32	0	0	1672	251	2	0	V1		9-50
9-51	367	MEL-SOC	- 6	- 6	36.5	36	10	42	43	1.06	0	451	10	4	2	0	V2		9-51
9-52	405	MEL-SOC	1	1	29	29	6	35	39	2.10	0	0	1434	98	1	0	S1		9-52

Table C-9. CONUS IST Loops (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	P_J^P	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Line Character.	Comments	Table #
9-53	368	MEL-APA	-4	-3	36.5	31.5	18	37	28	4.22	0	0	79	3	0	0	V1		9-53
9-54	406	MEL-APA	-2	-2	33	26	8	44	30	3.22	0	0	1997	502	3	0	V2		9-54
9-55	369	MEL-CMC	4	5	30.5	29.5	7	48	34	2.03	0	0	295	1	0	0	V2		9-55
9-56	407	MEL-CMC	1	0	39.5	27	8	37	32	2.88	0	0	1408	396	35	0	V2		9-56
9-57	370	MEL-LAM	0	0	32	31	6	49	32	2.54	0	0	494	0	0	0	V1		9-57
9-58	408	MEL-LAM	-3	-3	29	26	9	43	30	3.24	8	17	1898	1144	94	0	V2		9-58
9-59	371	MEL-MOU	2	3	34.5	30	5	40	31	2.93	0	1	230	1	0	0	V1		9-59
9-60	409	MEL-MOU	0	0	32.5	28	5	39	30	3.36	0	0	1239	6	2	0	V2		9-60
9-61	372	MEL-LYO	1	2	34	30.5	7	44	32	2.59	0	0	751	0	0	0	V1		9-61
9-62	410	MEL-LYO	-1	-1	30.5	26	8	41	31	2.95	0	0	1873	861	1	0	V2		9-62
9-63	339	MEL-HEL	1	1	32	28	14	48	32	2.54	-	-	-	-	-	-	V1		9-63
9-64	411	MEL-HEL	-2	-2	28	25	18	35	31	3.33	1	317	1729	1434	12	0	V1		9-64
9-65	373	MEL-LOD	0	1	33.5	28	9	34	31	3.45	0	0	947	1	0	0	V1		9-65
9-66	412	MEL-LOD	-1	0	29	25	10	39	32	2.75	0	5	1725	[illegible]	3	0	V2		9-66
9-67	374	MEL-JUL	5	5	32	24.5	24	42	36	1.77	0	100	1764	597	1	0	V1		9-67
9-68	413	MEL-JUL	-1	-1	29	27	6	36	32	2.97	0	0	1782	155	3	0	V1		9-68
9-69	375	MEL-MOJ	5	5	31	29.5	8	36	34	1.58	0	0	247	3	0	0	V2		9-69
9-70	414	MEL-MOJ	-1	-1	28	28	7	36	31	3.23	0	1	1761	241	6	0	V1		9-70
9-71	376	MEL-SLO	8	8	29.5	29.5	7	41	42	1.19	0	0	25	7	3	0	V2		9-71
9-72	415	MEL-SLO	-3	-2	30	26	7	35	28	4.36	0	0	1640	137	3	0	V2		9-72
9-73	377	MEL-SMF	-1	0	35.5	28.5	12	40	27	4.58	0	0	1773	140	2	0	V1		9-73
9-74	416	MEL-SMF	-1	-1	31	24	13	41	29	3.66	0	1	1840	989	2	0	V2		9-74
9-75	378	MEL-SHE	-3	-2	34	29	10	35	29	3.97	0	0	1731	185	0	0	V1		9-75
9-76	417	MEL-SHE	-3	-3	32	24	9	44	29	3.60	0	0	1815	674	3	0	V1		9-76
9-77	379	MEL-FRE	-1	-1	34	26	15	33	36	2.74	0	0	1858	953	0	0	V1		9-77
9-78	418	MEL-FRE	-3	-2	31	24	11	36	28	4.28	0	0	1050	1800	8	0	V1		9-78

Table C-10. Special Calls (Sheet 1)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	Type of Call	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
10-1	257	Pearl Harbor, Hawaii - Wahiawa, Hawaii	12/13	1022	0	0	100	Pacific Access Loop	0	0	1.25E-6	1.25E-6	4-4	30	10-1
10-2	157	Coltano, Italy - Hillingdon, Eng	11/24	1612	4.25E-3	5.12E-5	88	Combination Call	4.25E-3	4.33E-3	7.84E-3	4.08E-3	4-4	20	10-2
10-3	158	Looped on 157	11/24	1632	3.80E-2	1.32E-3	24	Combination Call	3.80E-2	4.85E-2	3.28E-2	3.86E-2	4-4	15	10-3
10-4	333	Pearl Harbor, Hawaii, Lua Lua Lei, Hawaii	12/17	0932	9.87E-3	0	100	HF Loop	6.23E-3	7.60E-3	6.56E-3	7.04E-3	5-5	21	10-4
10-5	183A	Christchurch, Eng - Oakhanger, Eng	11/29	1020	0	-	-	GPO Loop	0	0	0	0	3-3	-	10-5
10-6	183B	Christchurch, Eng - Whitehall, Eng	11/29	1030	5.00E-6	-	-	GPO Loop	5.00E-6	1.25E-5	5.00E-6	2.50E-6	2-2	-	10-6
10-7	250	Hillingdon, Eng - Cedar Brook, NJ	12/3	1846	1.12E-2	-	-	Cedar Brook Loop	1.12E-2	-	-	-	1-1	20	10-7
10-8	217	Hillingdon, Eng - Ft. Dietrich, Md	12/1	2030	1.29E-1	-	-	Ft. Dietrich Loop	1.29E-1	-	-	2.31E-1	1-1	14	10-8
10-9	251	Hillingdon, Eng - Pottstown, Pa	12/3	1855	7.69E-2	-	-	Pottstown Loop	7.69E-2	-	-	-	1-1	18	10-9
10-10	241	Hillingdon, Eng - Ft. Dietrich, Md	12/2	1906	1.40E-1	-	-	Ft. Dietrich Loop	1.40E-1	-	-	1.93E-1	1-1	14	10-10
10-11	129A	Feldberg, Germ - Pottstown, Pa	11/19	0915	7.77E-2	-	-	Pottstown Loop	7.77E-2	-	-	-	4-4	-	10-11
10-12	129B	Feldberg, Germ - Pottstown, Pa	11/19	0915	2.52E-3	0	100	Pottstown Loop	2.52E-3	-	-	1.99E-3	3-3	22	10-12
10-13	306	Pearl Harbor, Hawaii - San Luis Obispo, Cal	12/15	1518	1.02E-3	0	100	San Luis Obispo Loop	1.02E-3	1.78E-3	1.37E-3	1.43E-3	4-4	23	10-13
10-14	307	Pearl Harbor, Hawaii - San Luis Obispo, Cal	12/15	1543	1.93E-3	0	100	Mojavi Loop	1.93E-3	2.22E-3	2.11E-3	1.88E-3	4-4	21	10-14
10-15	326	Pearl Harbor, Hawaii - Stockton, Cal	12/16	1520	1.32E-2	-	-	Stockton Loop	1.32E-2	-	-	1.58E-2	1-1	20	10-15
10-16	111	Feldberg, Germ - ?	12/17	1605	2.82E-2	1.17E-4	84	Lost Loop	2.82E-2	2.27E-2	6.69E-2	3.13E-2	5-5	20	10-16
10-17	127	Feldberg, Germ - ?	12/18	1702	2.82E-2	2.62E-5	79	Lost Loop	2.82E-2	3.66E-2	3.18E-2	2.72E-2	3-3	20	10-17
10-18	49	Hillingdon, Eng - Coltano, Italy	11/9	1440	1.50E-5	-	-	No routing	1.50E-5	-	-	-	2-2	25	10-18
10-19	11	Coltano, Italy - Leghorn, Italy	11/14	1528	7.50E-6	-	-	2 Wire Loop	7.50E-6	-	-	-	1-1	30	10-19
10-20	15	Coltano, Italy - Ankara, Turkey	11/5	0852	2.85E-1	-	-	2 Wire Loop	2.85E-1	-	-	-	2-2	10	10-20
10-21	16	Coltano, Italy - Ankara, Turkey	11/5	0900	3.65E-2	2.62E-5	92	2 Wire Loop	3.65E-2	4.07E-2	-	-	3-3	20	10-21
10-22	334	Pearl Harbor, Hawaii - Hillingdon, Eng	12/17	1100	1.25E-1	4.11E-4	-	WAH-HIN Loop	1.25E-1	-	-	-	2-2	-	10-22
10-23	69A	Coltano, Italy - Wahiawa, Hawaii	11/11	1132	1.81E-1	1.34E-2	-	CLO-WAH Loop	1.81E-1	-	-	-	3-3	12	10-23
10-24	17	Coltano, Italy - Aviano, Italy	11/5	0932	1.40E-1	-	-	SF Filter	1.40E-1	-	-	-	1-1	15	10-24
10-25	34	Coltano, Italy - Mt. Vergine, Italy	11/8	1041	7.72E-2	6.14E-3	-	1600 Notch	7.72E-2	1.75E-1	1.52E-1	6.46E-2	3-3	14	10-25
10-26	83	Feldberg, Germ - Ramstein, Germ	11/16	1000	-	-	-	Teletype Channel	-	-	-	-	1-0	-	10-26

Table C-10. Special Calls (Sheet 1 Continued)

Table #	Call #	Location	Date	Time	BER (A) 16-110	BER 8-110	BTP	Type of Call	BER (B) 16-110	BER 16-130	BER 16-111	BER 16-C	Sync Tries-Hits	S/N	Table #
10-27	98	Feldberg, Germ - Coltano, Italy	11/17	1048	1.68E-2	-	-	SF Filter	1.68E-2	3.90E-2	5.19E-2	-	2-2	14	10-27
10-28	165	Hillingdon, Eng - Mt. Pateras, Greece	12/25	1453	1.54E-1	2.19E-3	-	Bad Channel	1.54E-1	-	-	-	2-2	12	10-28
10-29	261	Pearl Harbor, Hawaii - Fuchu, Japan	12/13	1225	-	-	-	Bad Channel	-	-	-	-	3-0	-	10-29
10-30	94	Feldberg, Germ - Stuttgart, Germ	11/16	1640	1.22E-1	2.49E-3	-	Pilot Stop Filter	1.22E-1	1.21E-1	1.23E-1	1.81E-1	3-3	15	10-30

Table C-10. Special Calls (Sheet 2)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
10-1	257	PHR-WAH	- 2	-2	38	39	1	46	48	.64	0	0	0	0	0	0	A	P1-1,099	C	PHR KC41 WAH	S3		10-1
10-2	157	CLO-HIN	6	4	28.5	30	8	45	50	.32	0	1	1224	86	14	0	A C	3-2,302	A-4	CLO9CUR(V2) VCZ9CUR(V2) CLO9CVN (V2) MRE9AEH(S3) HIN9DCG(V2) LDN9DCG(V2)HIN	V1		10-2
10-3	158	Looped (157)	11	8	25	26	12	45	49	.77	0	14	1846	992	41	2	A C	3-2,158	A-4	Looped on 157	V1		10-3
10-4	333	PHR-LUA	-11	-13	-	34	6	46	34	2.06	0	0	23	4	4	0	A	P2-1,249	B-4	PHR KC41 WAH —— LUA HF WAH KC41 PHR	S1		10-4
10-5	183A	CHR-OAK	0	0	46	46	1	54	51	.35	0	0	0	0	0	0	A	—	-	CHR PW19673 OAK	V2		10-5
10-6	183B	CHR-WTL	4	3	43	43	1	41	48	.98	0	0	2	0	0	0	A	—	-	CHR PW46307 WTL	V2		10-6
10-7	250	HIN-CED	5	4	26	27	9	45	40	1.15	-	-	-	-	-	-	A	—	-	HIN B478 (S3) CED	V2		10-7
10-8	217	HIN-FTD	5	5	25	22	17	∞	29	3.55	-	-	-	-	-	-	A	—	-	HIN B478 (S3) CED —— FTD	V2		10-8
10-9	251	HIN-POT	3	2	28	23	9	28	36	4.28	-	-	-	-	-	-	A	—	-	HIN B431 (S3) POT	V1		10-9
10-10	241	HIN-POT	0	1	30	23	11	29	24	7.24	-	-	-	-	-	-	A	—	-	HIN B431 (S3) POT —— FTD	V1		10-10
10-11	129A	FEL-POT	3	1	34.5	35	25	40	41	1.34	-	-	-	-	-	-	A	3-1,272	A-5	FEL B418 (V2) POT	V1		10-11
10-12	129B	FEL-POT	4	3	32	37	10	40	43	1.23	-	-	-	-	-	-	A C D	3-1,303	A-6	FEL B400 (S3) POT	V1		10-12
10-13	306	PHR-SLO	- 3	- 3	32	31	4	43	35	1.91	0	0	72	3	2	0	A	P1-2,471	B-3	PHR KC41 WAH B361 LOD — SLO	V1		10-13
10-14	307	PHR-MOJ	- 3	- 4	35	34	4	39	34	2.29	0	0	1	0	0	0	A	P2-1,000	C	PHR KC41 WAH B322 SLO — MOJ	V2		10-14
10-15	326	PHR-STK	2	3	29	28	8	39	30	3.35	-	-	-	-	-	-	A	P2-1,184	B-1	PHR KC41 WAH B322 SLO — STK	V2		10-15
10-16	111	FEL- ?	4	4	26	25	11	40	42	1.28	20	36	1878	1614	233	0	A C	3-1,081	C	FEL 9CFB (V2) DON — ?	S1		10-16
10-17	127	FEL- ?	- 2	- 5	31	30	14	42	42	1.12	7	27	1130	284	70	1	A C	—	-	FEL 9CFC (V2) DON 9CKZ (V2) MRE- ?	V2		10-17
10-18	49	HIN-CLO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	HIN —— CLO	-		10-18
10-19	11	CLO-LEG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	CLO —— LEG	-		10-19
10-20	15	CLO-ANK	5	5	31	27	-	-	-	-	-	-	-	-	-	-	-	—	-	CLO —— ANK	-		10-20
10-21	16	CLO-ANK	21	21	22	24	10	36	39	1.94	-	-	-	-	-	-	A	—	-	CLO 9DQD (V2) MRE — PAT — ANK	V2		10-21
10-22	334	PHR-HIN	-15.5	-16	28	27	8	38	25	5.76	0	19	1416	28	0	0	A	P2-1,280	B-3	PHR KC41 WAH —— LOD —— HIN	V1		10-22
10-23	69A	CLO-WAH	9	8	23	23	19	34	33	2.99	0	33	1876	1997	1400	0	A	2-1,318	E-1	CLO —— MRE —— WAH	V2		10-23
10-24	17	CLO-AVO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	—	-	CLO 9DSM (V2) AVO	-		10-24

Table C-10. Special Calls (Sheet 2 Continued)

Table #	Call #	Location (Abbrev.)	Line Loss (Data)	Line Loss (1 kHz)	S/N (Data)	S/N (1 kHz)	PJ°	HD 2nd	HD 3rd	HD%	GH +3	PH 20°	59	63	67	DO	Types of Pictures	Location of Recording	Type of Recording	Routing	Line Character.	Comments	Table #
10-25	34	CLO-MRE	9	7	32	33.5	12	∞	∞	0	-	-	-	-	-	-	A	—	-	CLO 9CUV (V2) FEL 9CEX (V2) MRE	V1		10-25
10-26	83	CLO-RSN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	—	-	FEL 44JNQ5-12 (RC) LKF 44JMH 5-2 (SC) BAN 564TX, 565REG	V1		10-26
10-27	98	FEL-CLO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	—	-	FEL 9CUV (V2) CLO	None		10-27
10-28	165	HIN-PAT	11	19	22	16	24	33	27	2.65	-	-	-	-	-	-	AD	—	-	HIN 9AEA (V2) MRE —— PAT	None		10-28
10-29	261	PHR-FUC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	—	-	PHR KC41 WAH KM93 FUC	None		10-29
10-30	94	FEL-SGT	2	6	41	34	5	54	47	.49	0	1	3	2	1	2	A	—	-	FEL WC7Y V1 SGT	V1		10-30

Table C-11. Comments

Call No.	Comment No.	
2	1	Noticeable amplitude variation
3	14	SF filter inserted before recordings
20	15	Signal cut on and off several times prior to the 8 kb test
24	7	Faded for about 1 minute and came back prior to the 16-C test
33	9	Lost signal for several seconds during measurement of 16-C and at beginning of 8 kb test
35	8	Line dropped out during hit measurement
36	6	Line dropped during 16-130 measurement and came back
39	5	Appeared to be alternate routed for a brief period
43	12	Very bursty. No errors except for bursts
46	27	Bursty during recording
66	22	Lots of signal losses between BER and Line Test Data
75	17	Errors in bursts only
82	24	Gain varied 2 dB during 8 kb recording
86	23	S/N ratio varied widely
88	25	Very full weights. Periodic noise. Signal level jumped by 24 dB during bit count. Hit count not taken
90	18	Several signal level changes during measurements
92	16	Fine structure in amplitude response due to channel fading
95	3	Most errors are amplitude errors

Table C-11. Comments (Continued)

Call No.	Comment No.	
97	4	Most errors are amplitude errors
99	2	Lissajou Pattern shows periodic phase jitter
123	19	Several dropouts after sync
126	20	Line frequency A.M.
128	10	Lost line for 1 second - then 20 seconds - came back 8 dB down then back to original level
141	21	Dropped line for a second prior to 8 kb test
180	11	Appeared to be a change in channel characteristics during 16-C measurement 8 dB change in level
186	28	Low frequency phase jitter (1 Hz 30° p-p) not registered on Halcyon
187	29	Bad echos
188	30	Low frequency phase jitter
192	32	Interuption with test tone for about a minute
208	33	Double terminated at HIN
224	31	30° p-p low frequency phase jitter
226	26	Level changes of 6 dB during initial setup and hit measurement
267	34	Dialed datagrade
269	35	Dialed datagrade
276	36	36° p-p phase jitter at approximately 10 Hz
295	37	Signal level fluctuations of 6 dB and back
81	13	Receive level fluctuations of 6 dB

APPENDIX D

PHOTOGRAPHS

D-1 INTRODUCTION

This appendix contains the data collected in the form of CRT photographs, and is divided by the type of data presented.

D-2 AMPLITUDE AND ENVELOPE DELAY PHOTOGRAPHS

As described in Paragraph 2.4, the Halcyon line tester presents the line amplitude response and envelope delay and a stored CRT display. This was photographed with a Polaroid camera for a hard copy record. Unfortunately, the line tester is not equipped with a camera mounting bezel so there is some variation in geometry between different photos, and in some cases the marking of frequency, amplitude and delay are not visible in individual pictures. However, the scales are the same on all photos and are as follows:

a. The horizontal (frequency) axis is 200 Hz per division and starts at 200 Hz on the left margin. The 1.0 kHz line is crossed with small horizontal tick marks.

b. The relative amplitude scale (vertical) is 2.5 dB per division.

c. The vertical envelope delay scale is 500 µs per division. (The finer amplitude and envelope delay scales were not used for these tests.)

When making frequency sweeps on the lines, the tester was set to automatically skip a band in the vicinity of the 2600 Hz single frequency (S.F.) signaling tone, to avoid disconnecting the line. This shows up as a discontinuity on some of the amplitude and envelope delay traces; the true response would be a faired curve through this region.

In the tables of Appendix C, the highest level of conditioning met by each test connection is given. In these judgements, the bias was in favor of the line, that is, if the characteristics were close to the specifications it was counted as complying.

For reference purposes, characteristics of the simulated lines in the Axel Model 771 simulator (3002, C1, C2, C4) were measured on the line tester and are enclosed.

All pictures in this appendix are indexed by their call number. To assist the reader in locating the other line data contained in Appendix C corresponding to this call number, a cross-reference from call number to table number is given in Table D-1.

D-3 PHASE JITTER PHOTOGRAPHS

On calls which measured more than approximately 15° p-p on the line tester, the jitter spectrum was recorded and photographed. As a calibration of this setup, the line simulator was set up with known jitter frequency and amplitude and the results photographed. The calibration points were 27° p-p at 150 Hz and 12° p-p at 180 Hz. The horizontal calibration for this photo was 100 Hz/division. For the line tests, it was found that 50 Hz/division gave a more interesting presentation, and all line photos have this scale factor. The vertical calibration is the same for the line and calibration photos, 10 dB per division. All line photos are identified by their call numbers.

D-4 AMPLITUDE VARIATION PHOTOGRAPHS

On calls which exhibited significant amplitude modulation (fading), a constant amplitude 1004 Hz tone was tranmitted and the received line signal photographed. The time base was chosen to best illustrate the nature of the AM, and is noted with each photo. In two cases (calls 41 and 86) two photos were made with different time bases.

Table D-1. Cross-Reference From Table Number to Call Number

Call No.	Table No.	Call No.	Table No.	Call No.	Table No.	Call No.	Table No.
1	2-1	28	1-8	55	1-2	81	1-83
2	1-7	29	1-54	56	1-13	82	3-18
3	2-3	30	1-53	57	1-10	83	10-26
4	1-11	31	1-55	58	1-3	84	3-19
5	2-6	32	1-56	59	1-14	85	3-20
6	1-16	33	1-57	60	3-2	86	3-15
7	1-17	34	10-25	61	3-3	87	3-21
8	3-1	35	1-52	62	1-15	88	3-22
9	1-18	36	1-47	63	3-4	89	2-16
10	1-1	37	4-1	64	3-10	90	2-17
11	10-19	38	4-2	65	3-12	91	2-9
12	1-19	39	1-44	66	3-13	92	2-12
13	1-6	40	4-41	67	3-14	93	2-18
14	1-20	41	1-4	68	3-11	94	10-30
15	10-20	42	4-7	69	1-21	95	1-26
16	10-21	43	1-81	69A	10-23	96	1-25
17	10-24	44	4-5	70	2-8	97	1-27
18	2-2	45	1-82	71	2-10	98	10-27
19	2-4	46	4-8	72	4-11	99	1-24
20	2-5	47	1-5	73	2-11	100	1-31
21	3-9	48	4-6	74	2-13	101	1-30
22	1-48	49	10-18	75	2-15	102	1-28
23	1-49	50	4-9	76	4-12	103	1-29
24	1-50	51	1-45	77	1-22	104	1-61
25	1-51	52	4-10	78	4-13	105	1-62
26	2-7	53	1-46	79	1-58	106	1-77
27	1-12	54	1-9	80	4-15	107	1-63

Table D-1. Cross-Reference From Table Number to Call Number (Continued)

Call No.	Table No.	Call No.	Table No.	Call No.	Table No.	Call No.	Table No.
108	1-66	133	4-16	160	1-34	185	
109	1-60	134	1-84	161	1-35	186	5-5
110	2-20	135	4-3	162	1-70	187	5-6
111	10-16	136	1-23	163		188	5-7
112	1-64	137	2-24	164	1-40	189	5-8
113	1-67	138	2-25	165	10-28	190	5-33
114	3-23	139	2-28	166	1-37	191	5-34
115	3-24	140	2-29	167	1-38	192	5-37
116	2-19	141	2-30	168	1-71	193	5-38
117	3-16	142	2-32	169	1-39	194	5-41
118	3-5	143	2-33	170	1-43	195	5-42
119	3-6	144	3-17	171	1-42	196	5-60
120	3-7	145	2-26	172	1-70	197	5-61
121		146	2-34	173	1-73	198	5-58
122		147	2-27	174	1-79	199	5-59
123	2-21	148	2-31	175	1-74	200	5-39
124	2-14	149	4-17	176	1-80	201	5-40
125	2-22	150		177	1-76	202	5-29
126	2-23	151	4-19	178	1-69	203	5-30
127	10-17	152	1-32	179	1-75	204	5-21
128	1-65	153	4-18	180	1-72	205	5-22
129	4-14	154	1-33	181	1-36	206	5-54
129A	10-11	155	4-21	182	3-8	207	5-55
129B	10-12	156	1-68	183	3-25	208	5-49
130	1-59	157	10-2	183A	10-5	209	5-50
131	4-20	158	10-3	183B	10-6	210	5-3
132	1-85	159	1-41	184		211	5-4

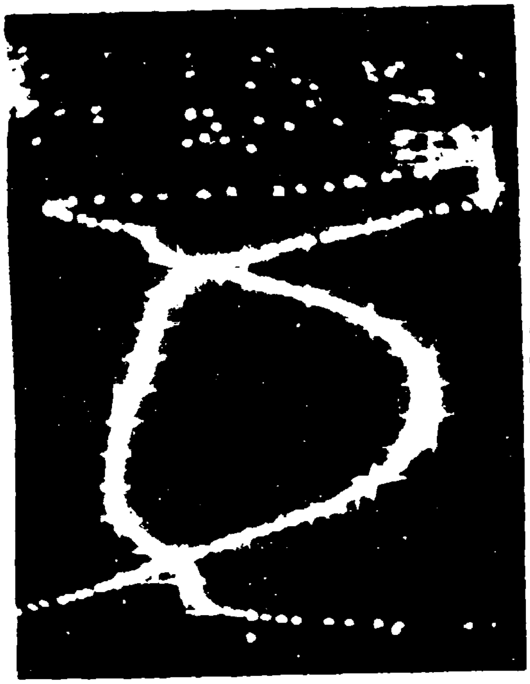
Table D-1. Cross-Reference From Table Number to Call Number (Continued)

Call No.	Table No.	Call No.	Table No.	Call No.	Table No.	Call No.	Table No.
212	5-25	239	5-57	266	7-5	293	8-5
213	5-26	240	5-45	267	6-34	294	9-2
214	5-15	241	5-46 (10-10)	268	6-35	295	8-4
215	5-16	242	5-17	269	6-42	296	8-1
216	5-27	243	5-18	270	6-43	297	
217	5-28 (10-8)	244	5-13	271	7-7	298	6-27
218	5-62	245	5-14	272	7-8	299	6-28
219	5-63	246	5-47	273	7-19	300	6-37
220	5-19	247	5-48	274	7-21	301	6-38
221	5-20	248	5-9	275	7-24	302	6-7
222	5-1	249	5-10	276	7-25	303	6-8
223	5-2	250	10-7	277	7-20	304	6-30
224	5-11	251	10-9	278	6-1	305	6-31
225	5-12	252	7-1	279	6-2	306	10-13
226	3-26	253	7-2	280	6-36	307	10-14
227	5-35	254	7-10	281		308	6-29
228	5-36	255	7-15	282	6-39	309	6-19
229	5-31	256	7-18	283		310	6-20
230	5-32	257	10-1	284		311	8-3
231	5-51	258	7-16	285	6-3	312	8-6
232	5-43	259	7-14	286	6-4	313	8-9
233	5-44	260	7-6	287	6-5	314	7-9
234	5-52	261	10-29	288	6-6	315	7-23
235	5-53	262	7-3	289	6-16	316	7-13
236	5-23	263	7-22	290	6-17	317	6-32
237	5-24	264	7-11	291	7-12	318	6-33
238	5-56	265	7-17	292	8-8	318A	6-18

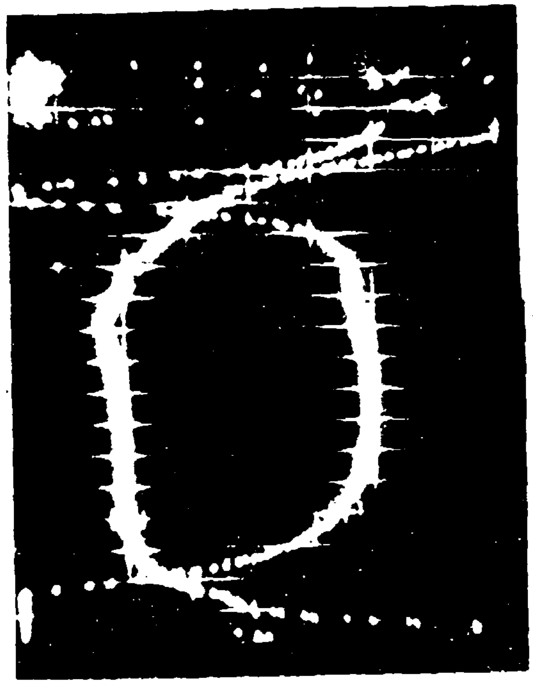
Table D-1. Cross-Reference From Table Number to Call Number (Continued)

Call No.	Table No.	Call No.	Table No.	Call No.	Table No.	Call No.	Table No.
319	6-11	346	9-13	373	9-65	400	9-42
320	6-12	347	9-15	374	9-67	401	9-44
321	6-21	348	9-17	375	9-69	402	9-46
322	6-22	349	9-19	376	9-71	403	9-48
323	6-13	350	9-21	377	9-73	404	9-50
324	6-14	351	9-23	378	9-75	405	9-52
325	6-15	352	9-25	379	9-77	406	9-54
326	6-9	353	9-27	380	9-2	407	9-56
327	6-10 (10-15)	354	9-29	381	9-4	408	9-58
328	8-7	355		382	9-6	409	9-60
329		356		383	9-8	410	9-62
330	6-23	357	9-31	384	9-10	411	9-64
331	6-24	358	9-33	385	9-12	412	9-66
332	7-4	359	9-35	386	9-14	413	9-68
333	10-4	360	9-37	387	9-16	414	9-70
334	10-22	361	9-39	388	9-18	415	9-72
335	6-25	362	9-41	389	9-20	416	9-74
336	6-26	363	9-43	390	9-22	417	9-76
337	6-40	364	9-45	391	9-24	418	9-78
338	6-41	365	9-47	392	9-26		
339	9-63	366	9-49	393	9-28		
340	9-1	367	9-51	394	9-30		
341	9-3	368	9-53	395	9-32		
342	9-5	369	9-55	396	9-34		
343	9-7	370	9-57	397	9-36		
344	9-9	371	9-59	398	9-38		
345	9-11	372	9-61	399	9-40		

AMPLITUDE AND ENVELOPE DELAY PHOTOGRAPHS

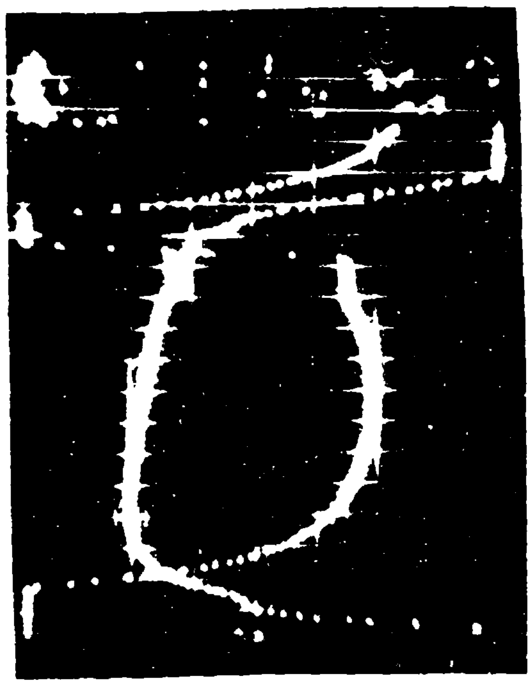


C-1

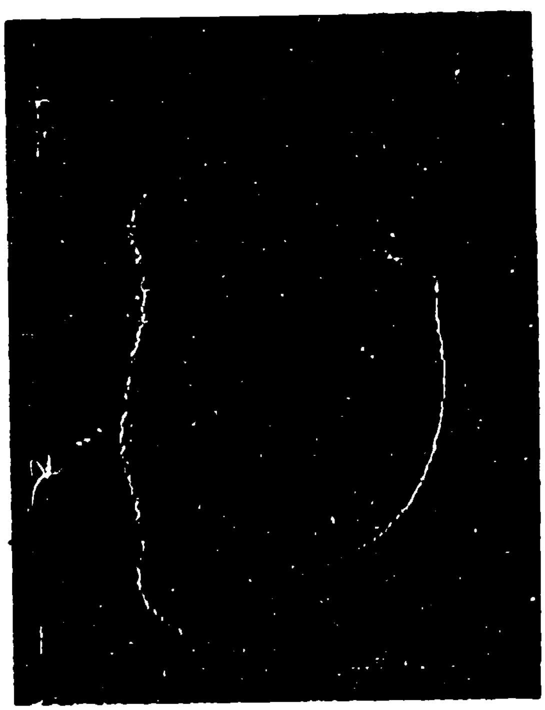


C-4

3002



C-2



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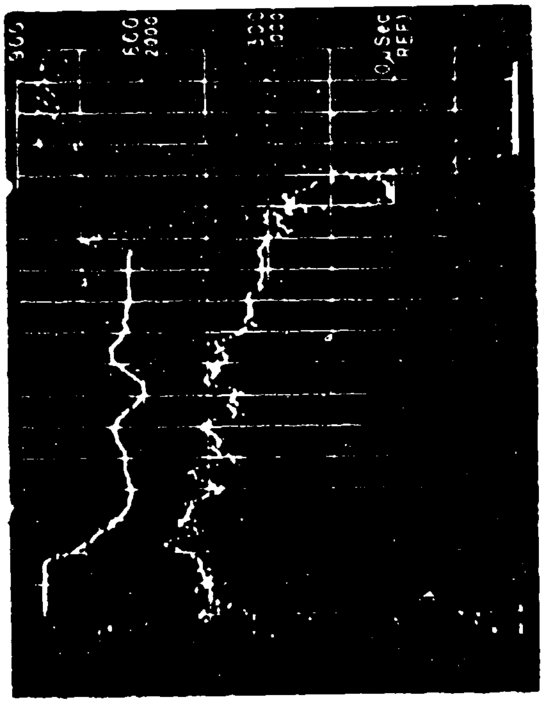

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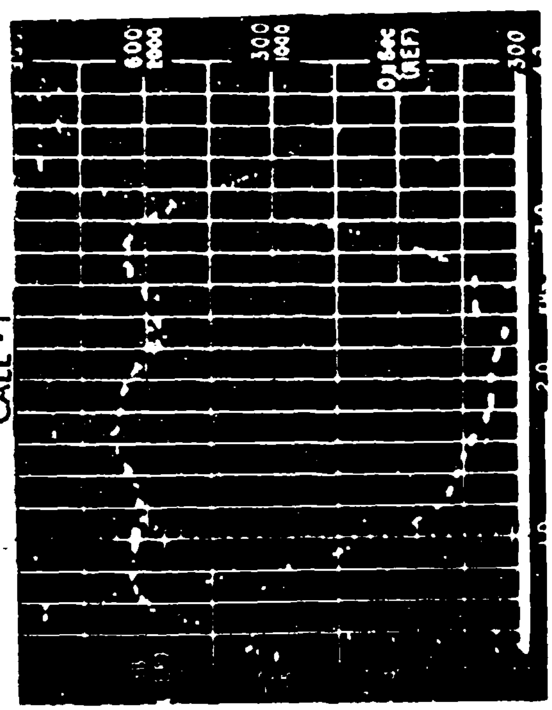

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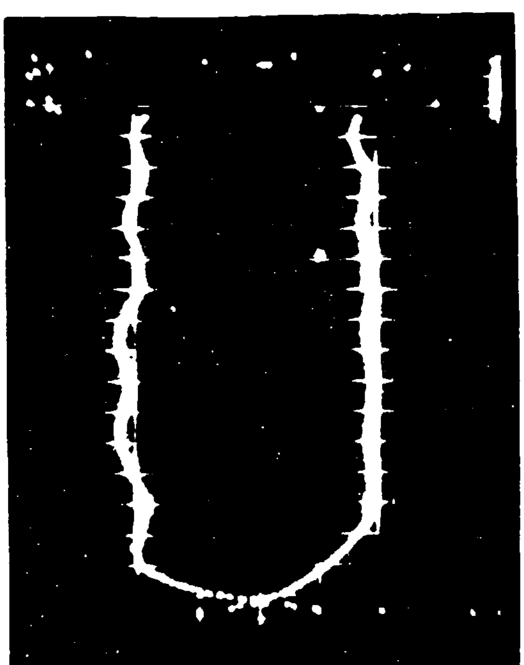

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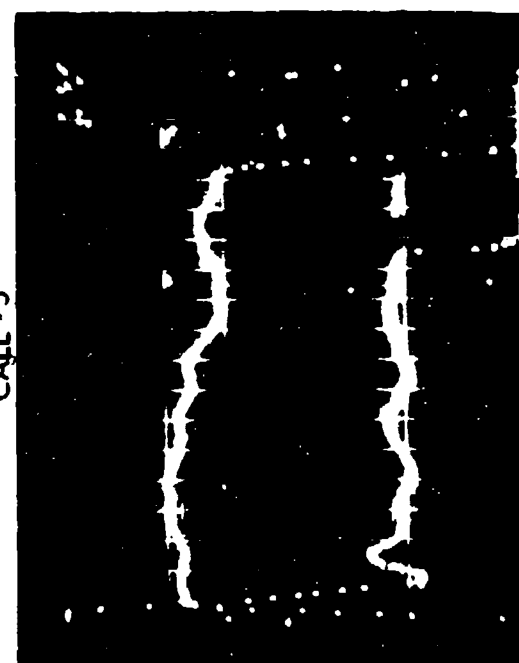

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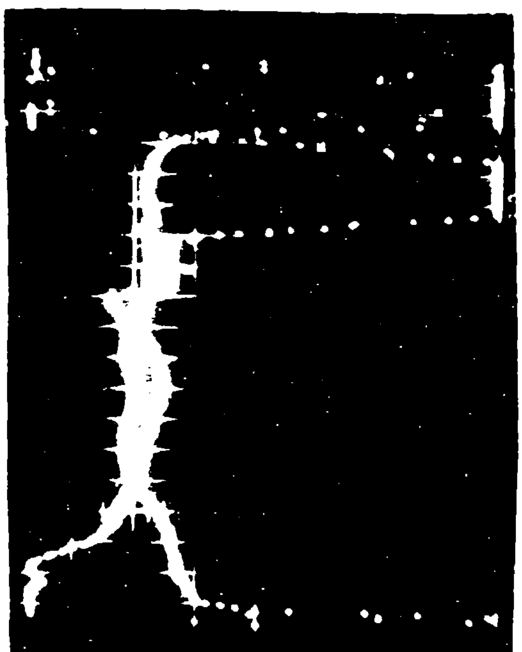

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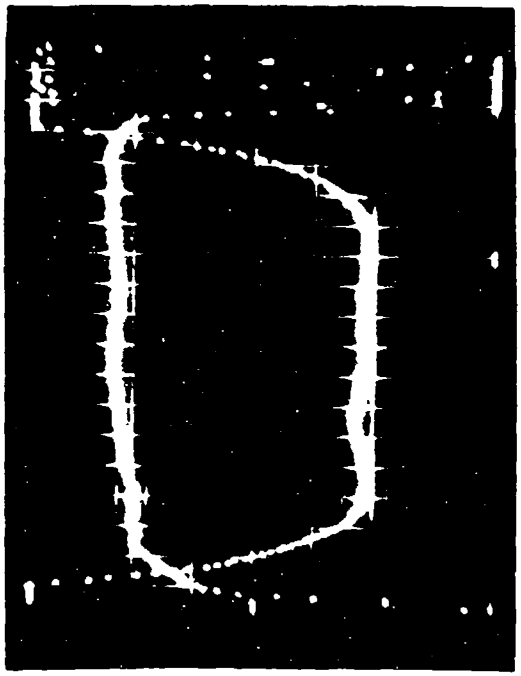

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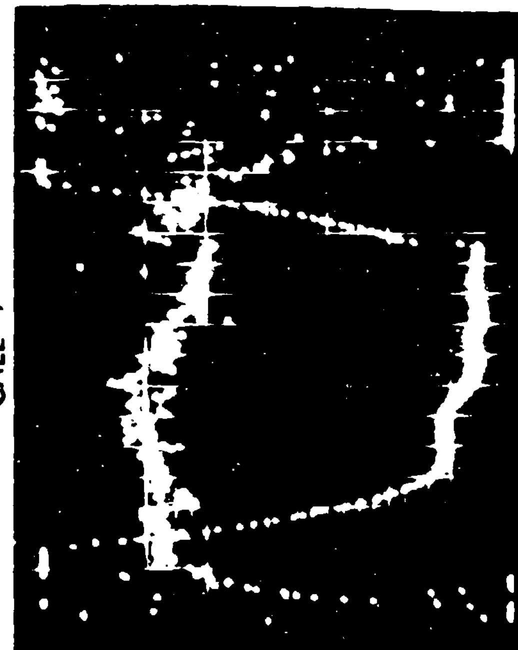

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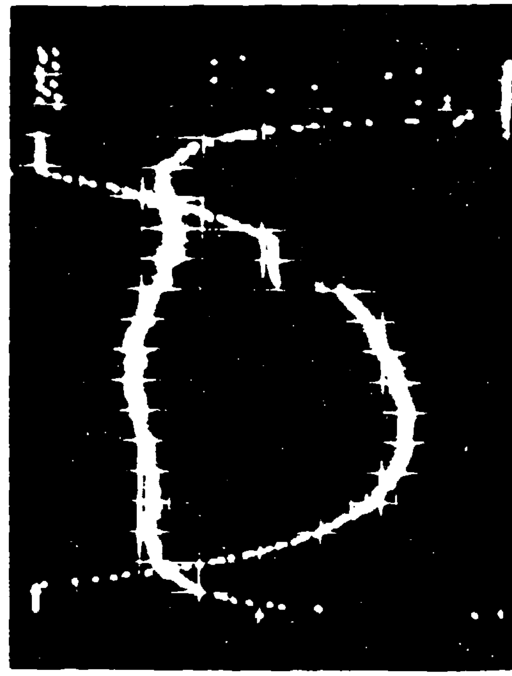

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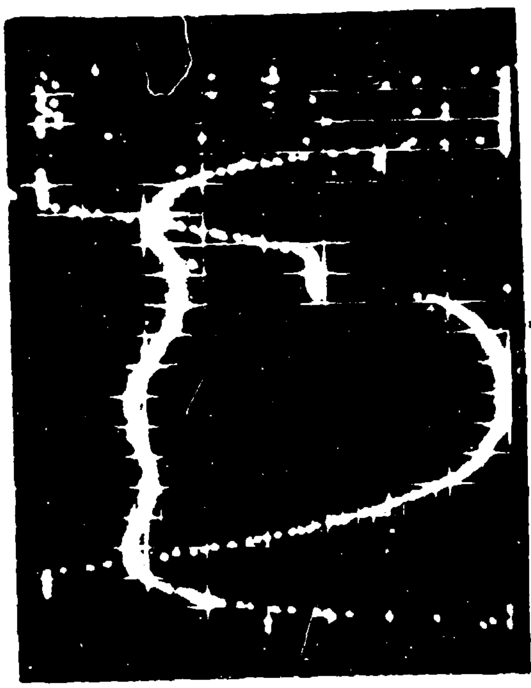

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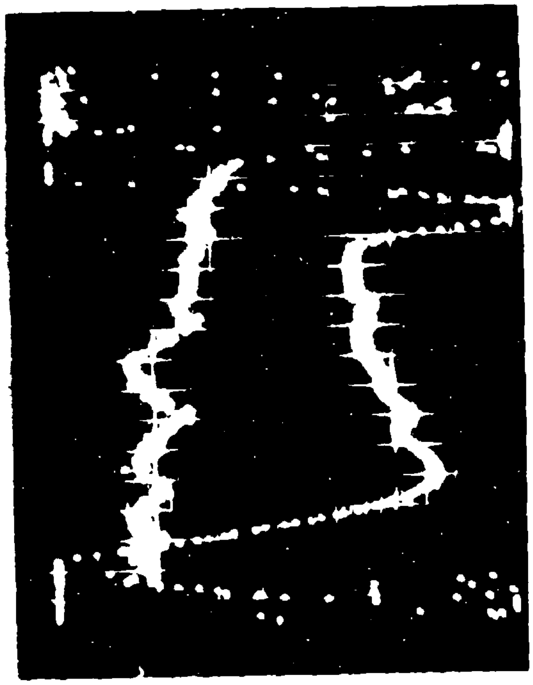

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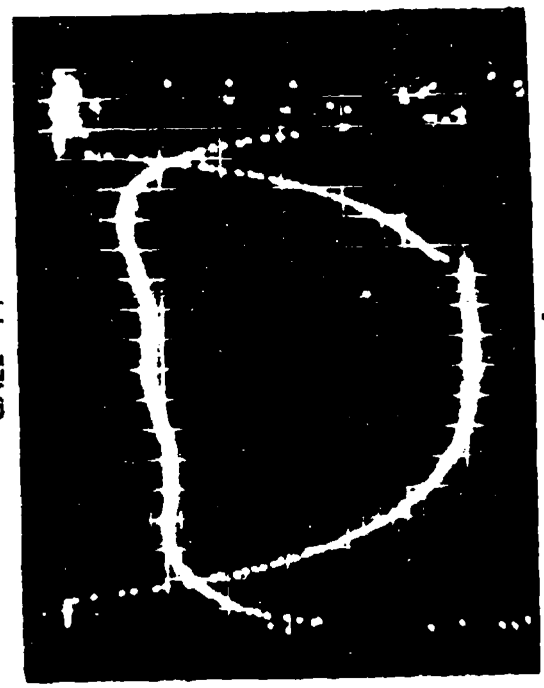

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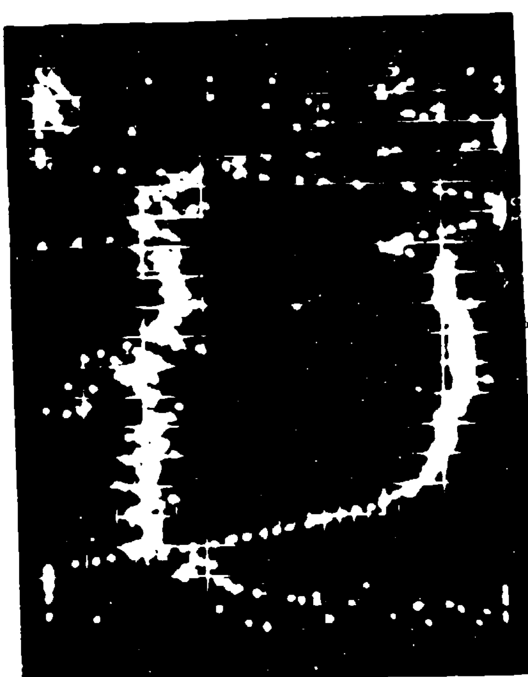

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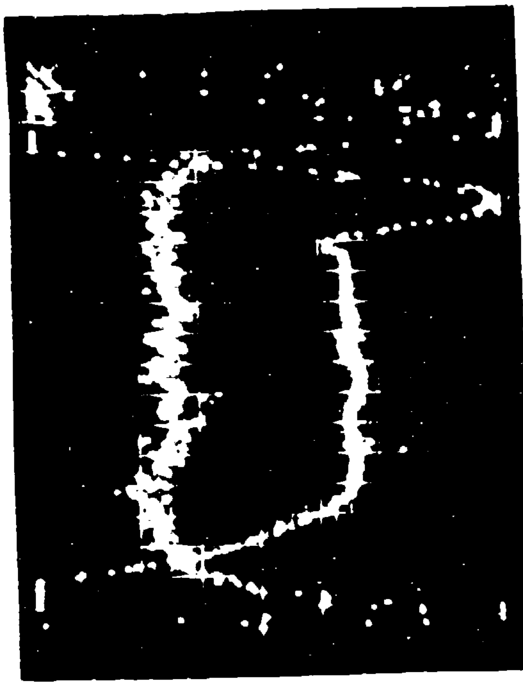

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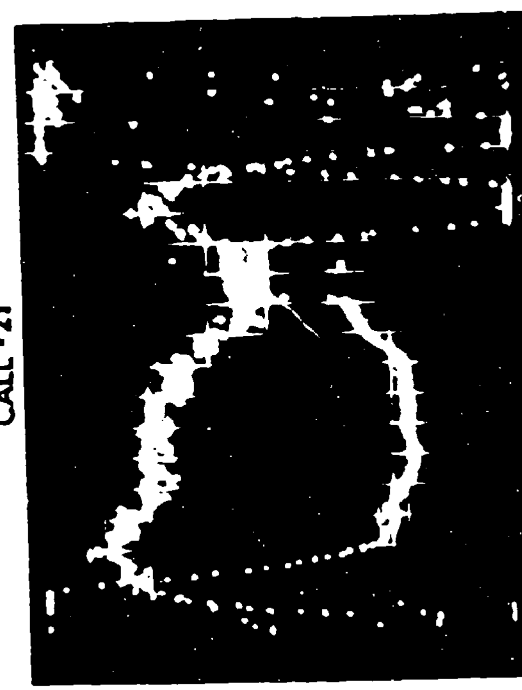

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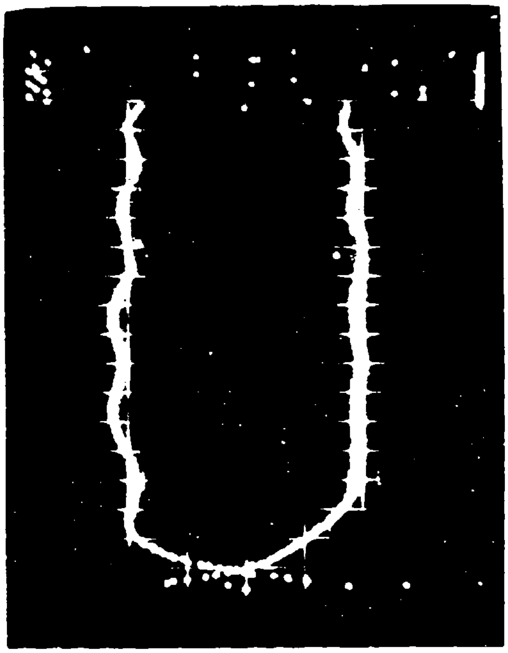

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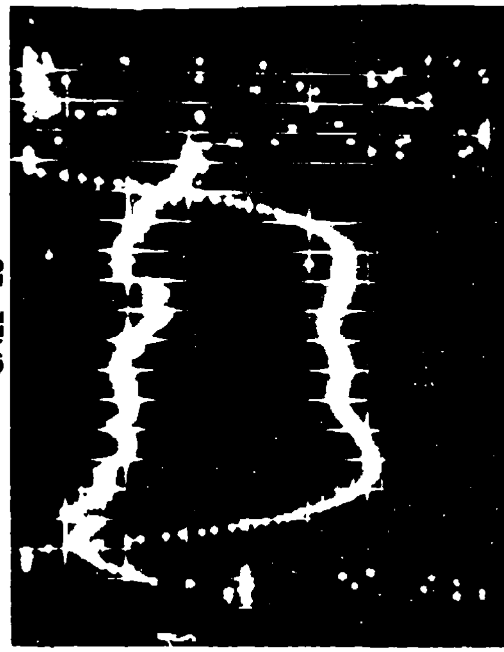

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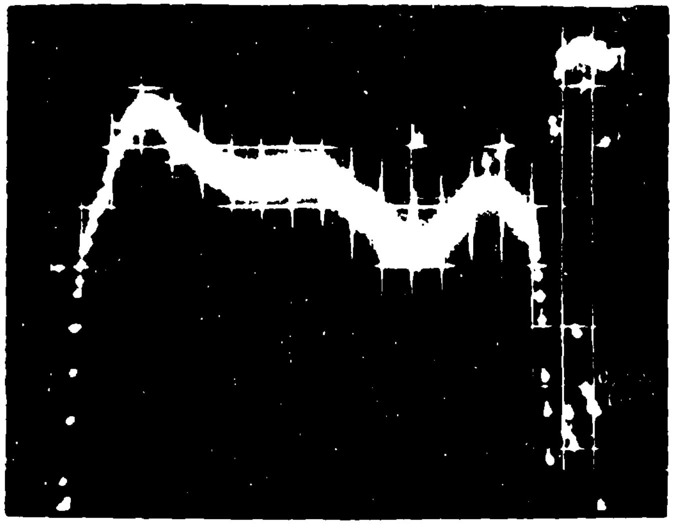

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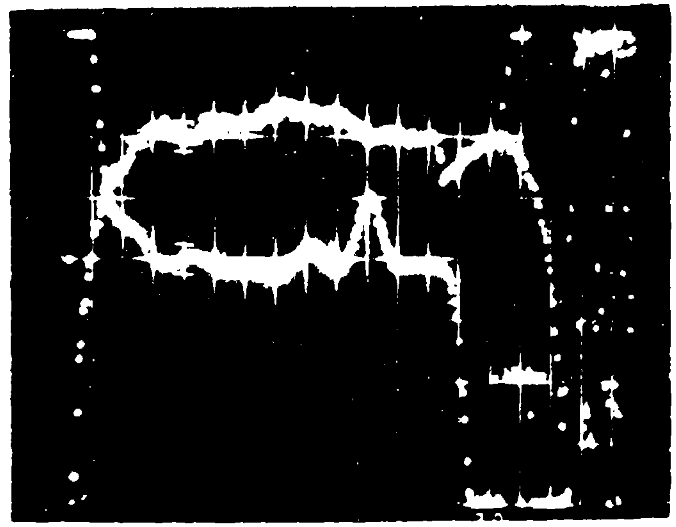

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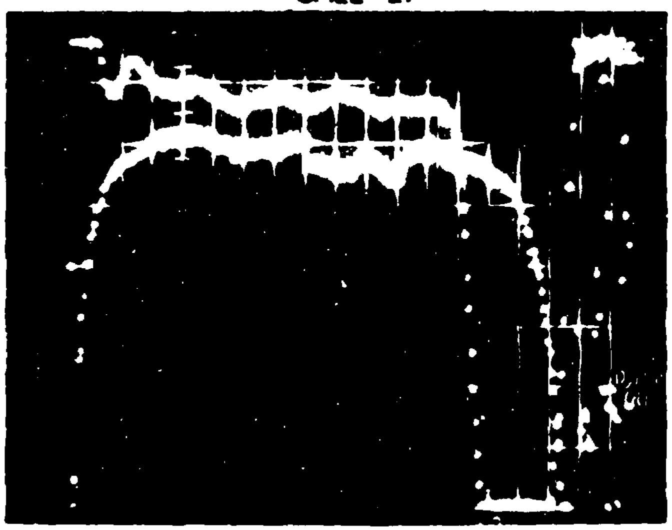

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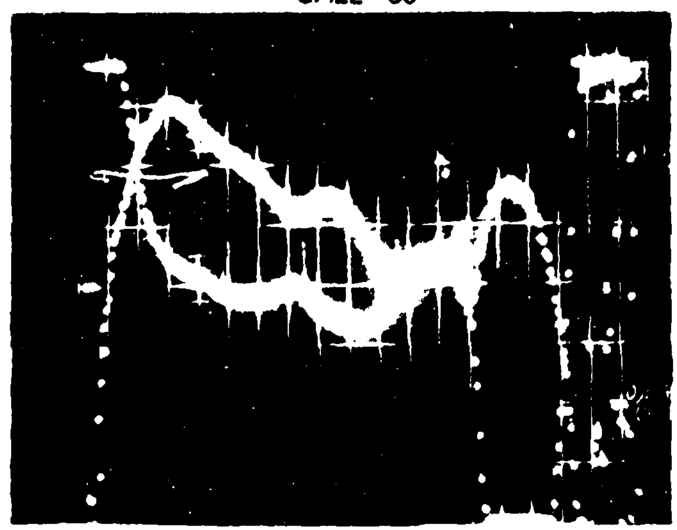

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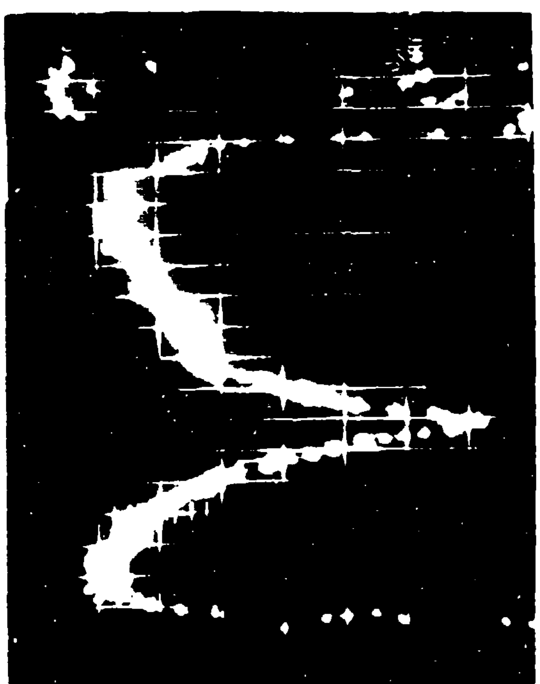

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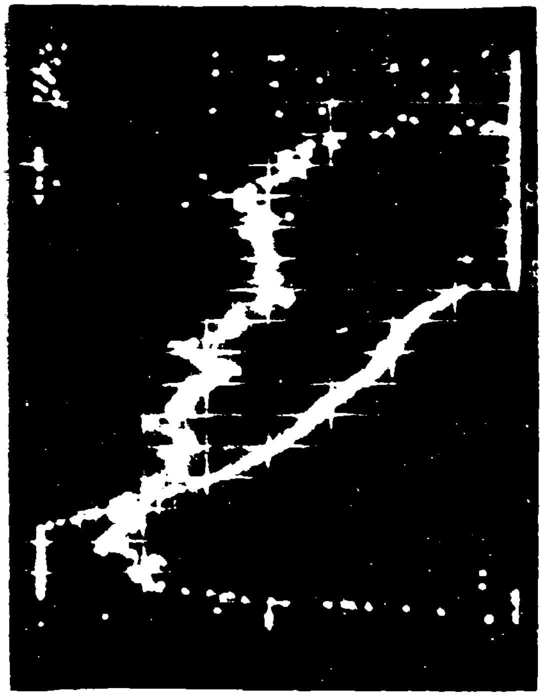

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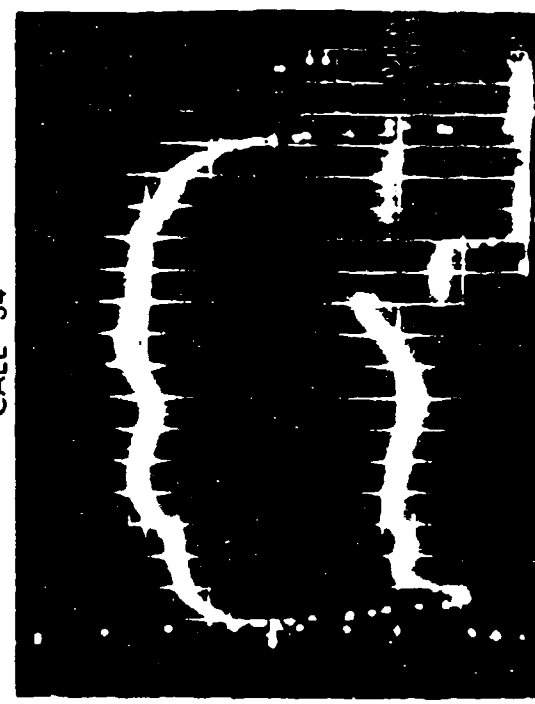

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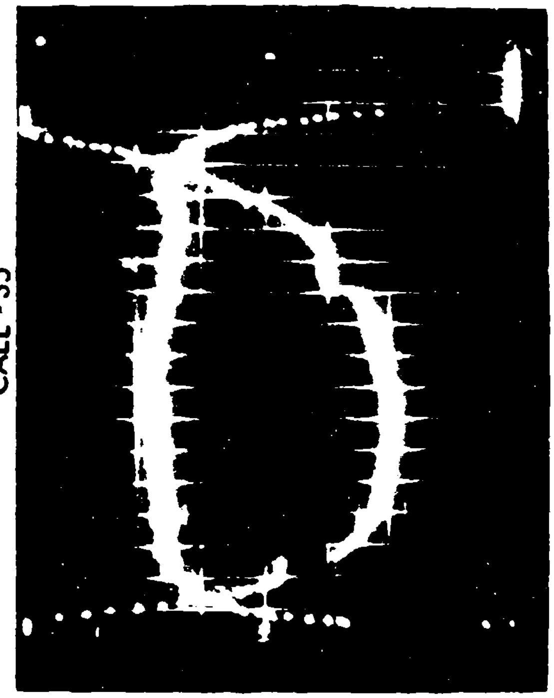

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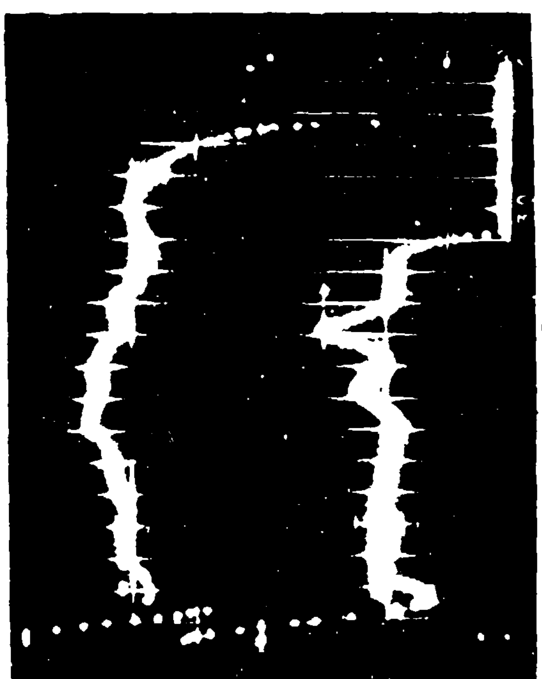

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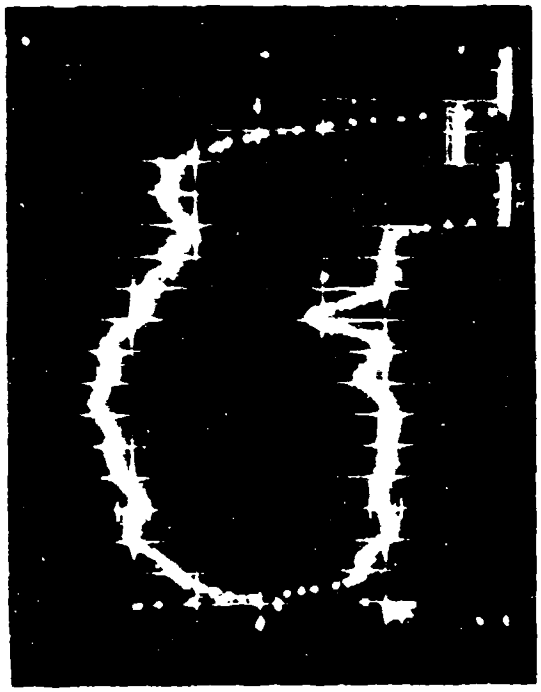

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CALL #40

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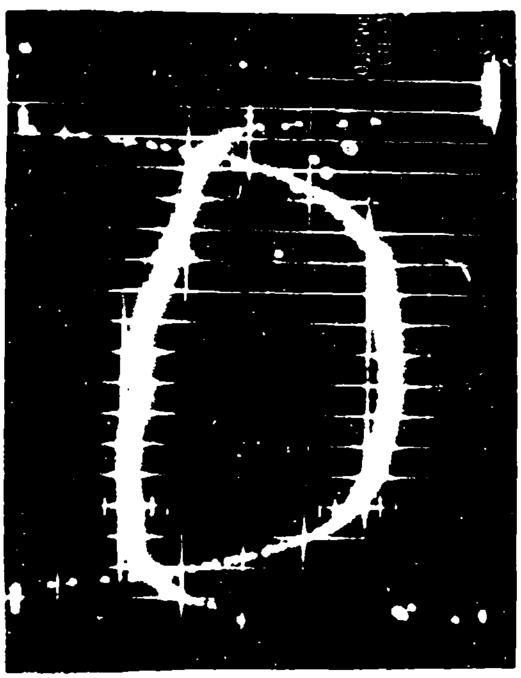

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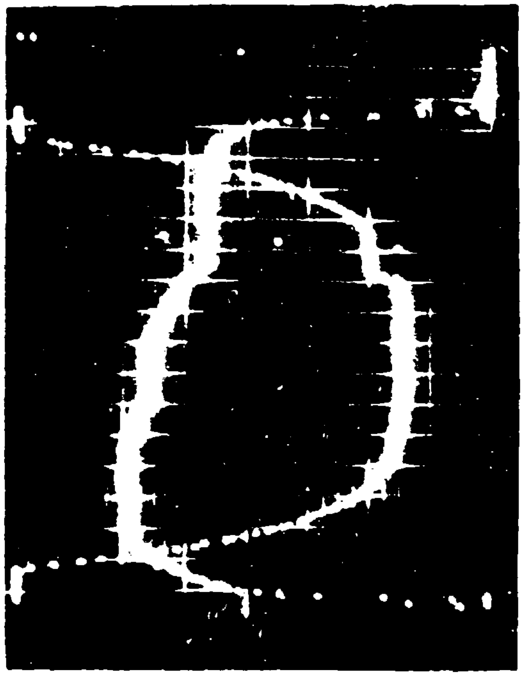

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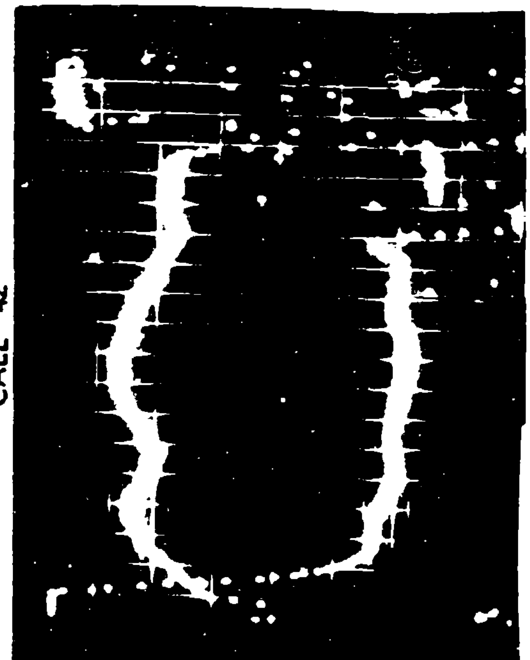

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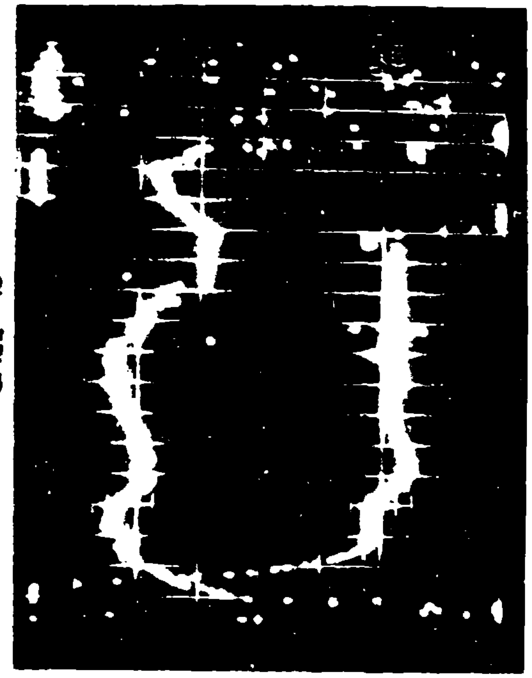

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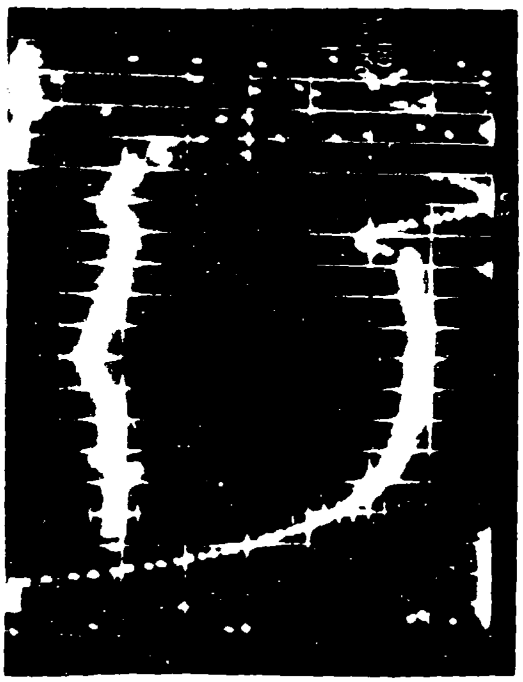

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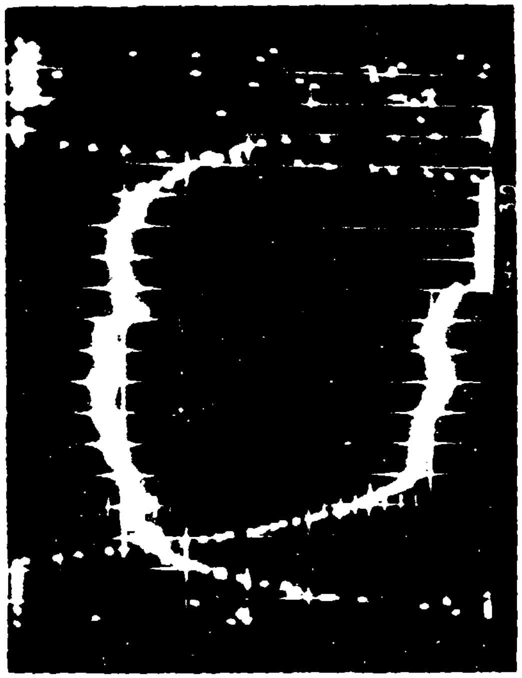

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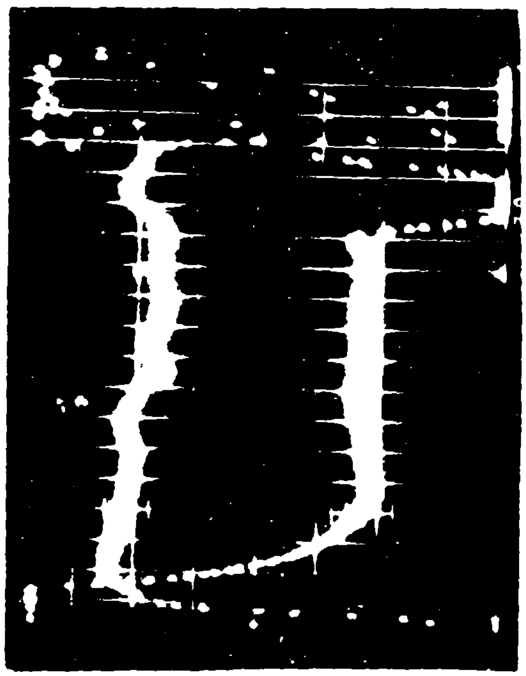

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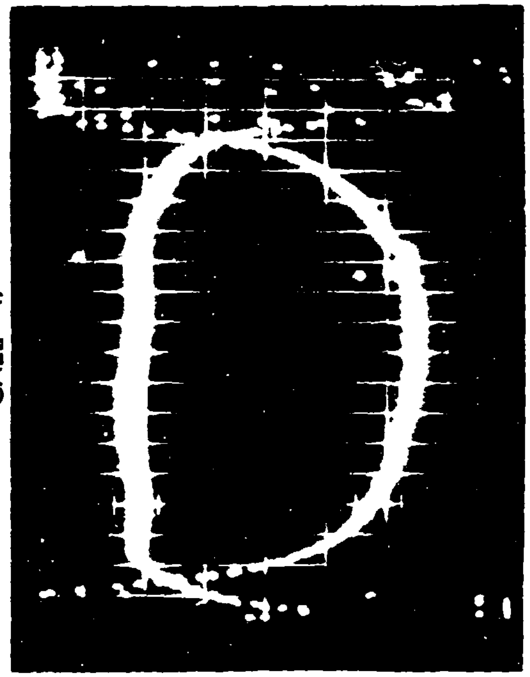

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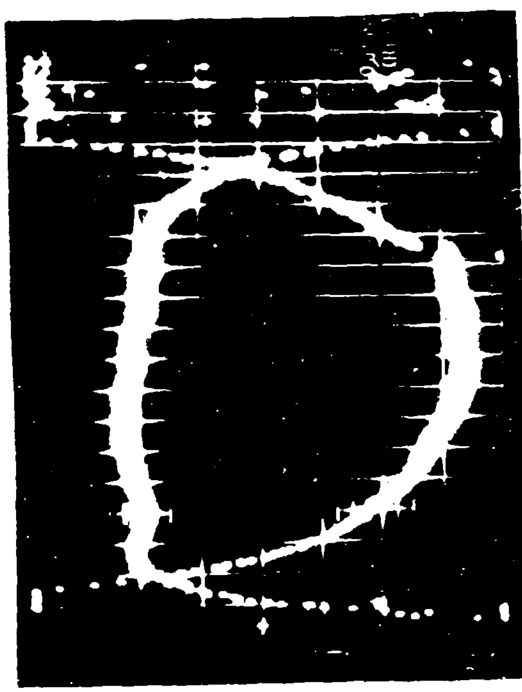

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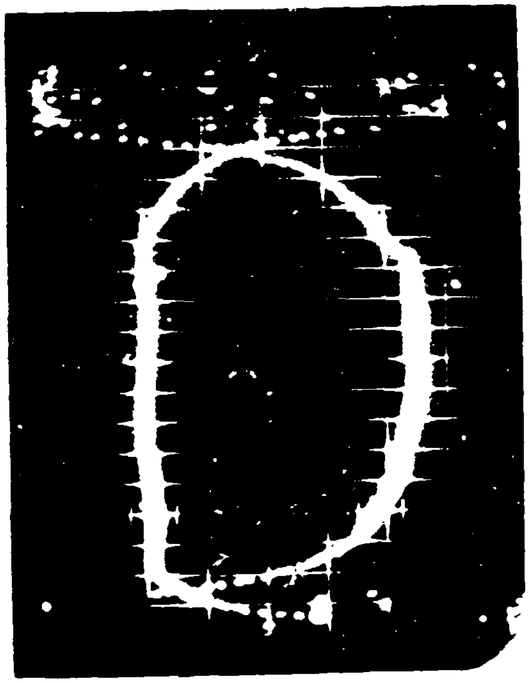

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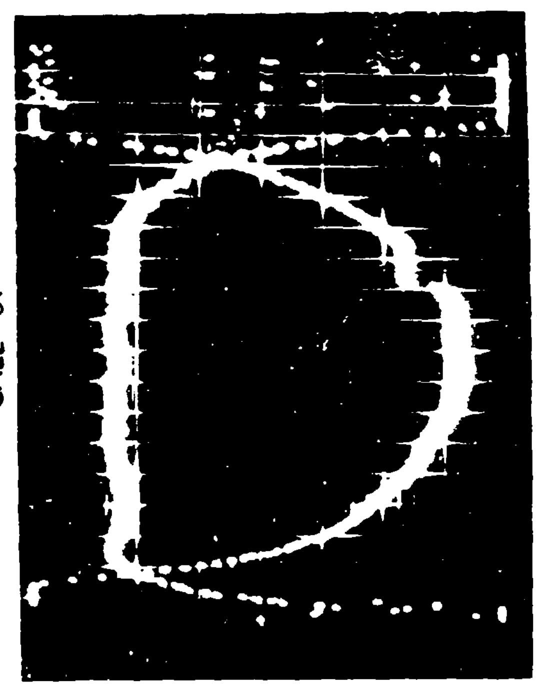

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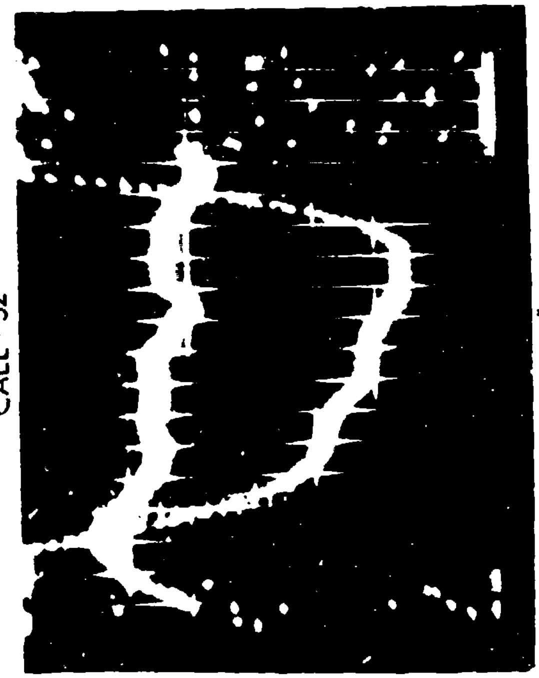

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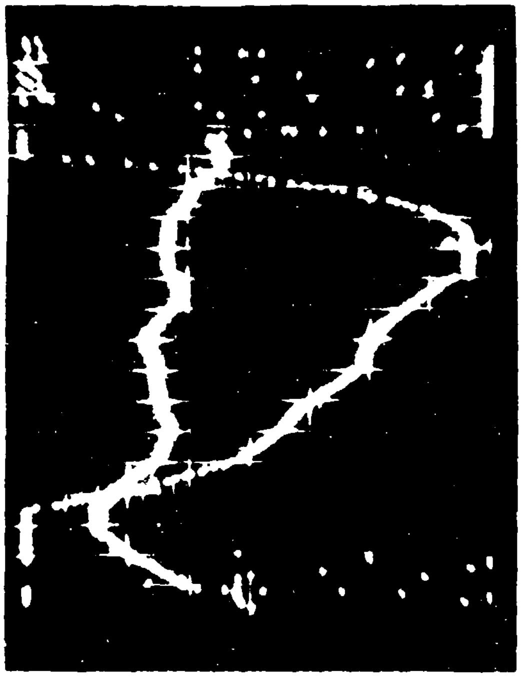

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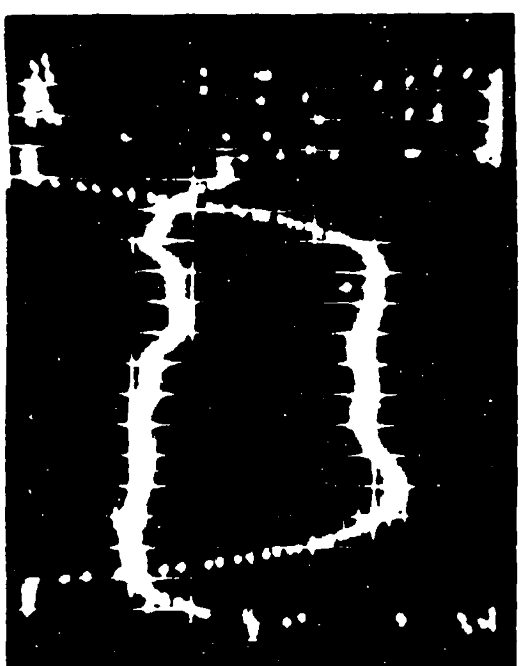

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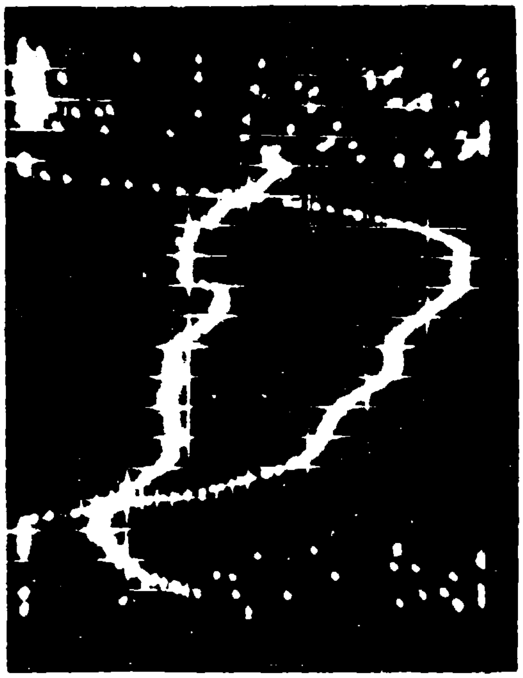

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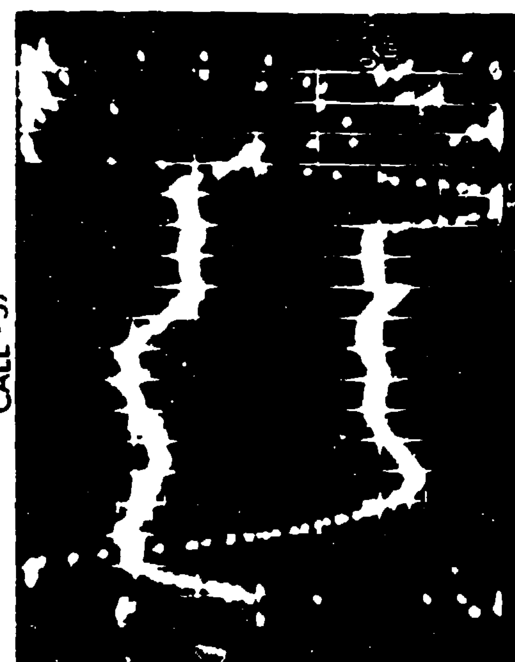

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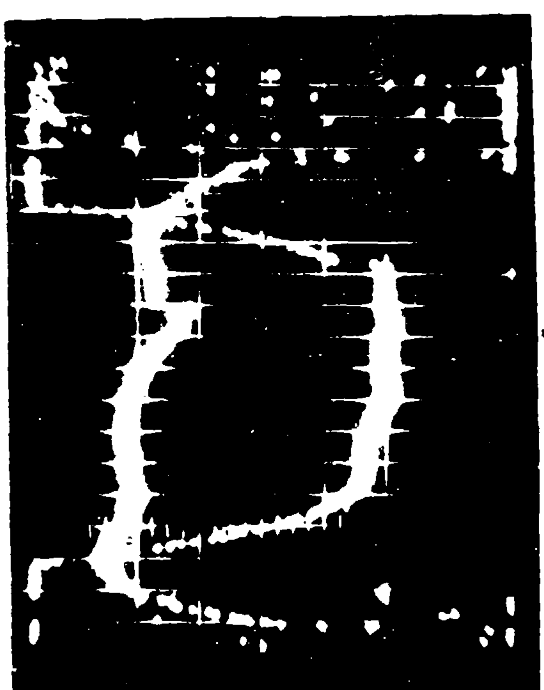

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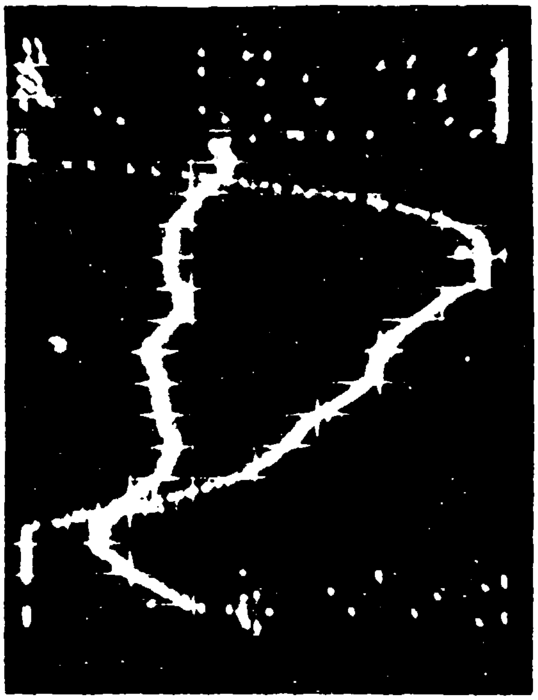

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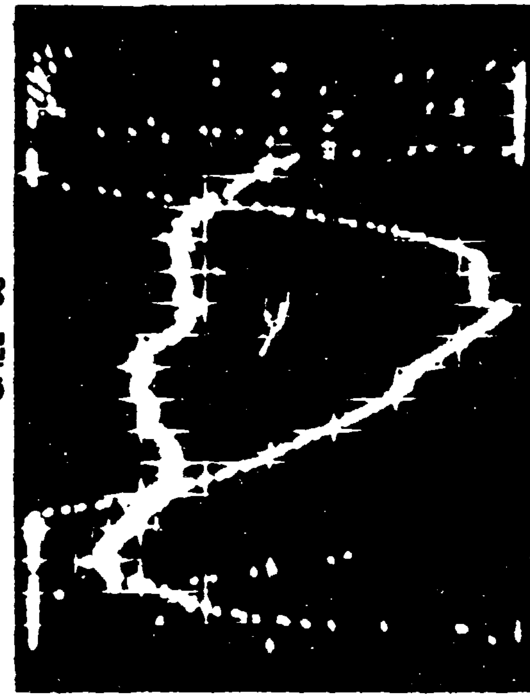

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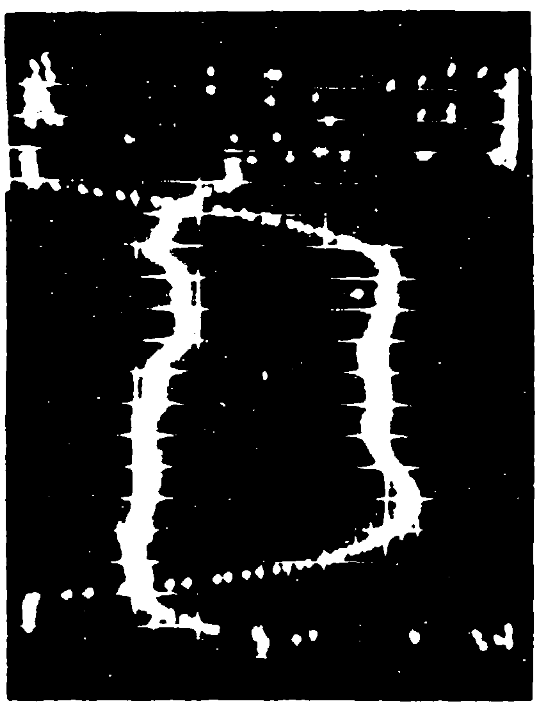

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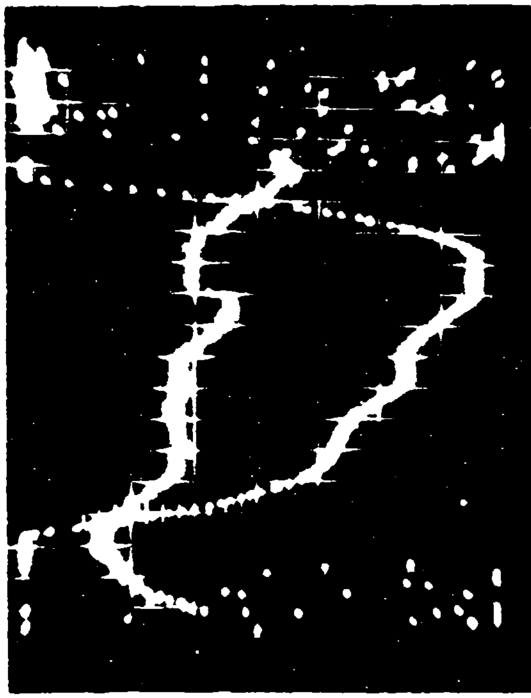

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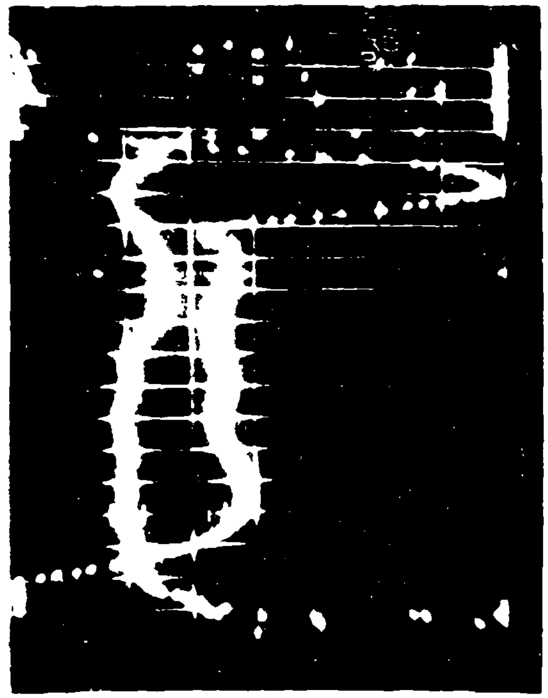

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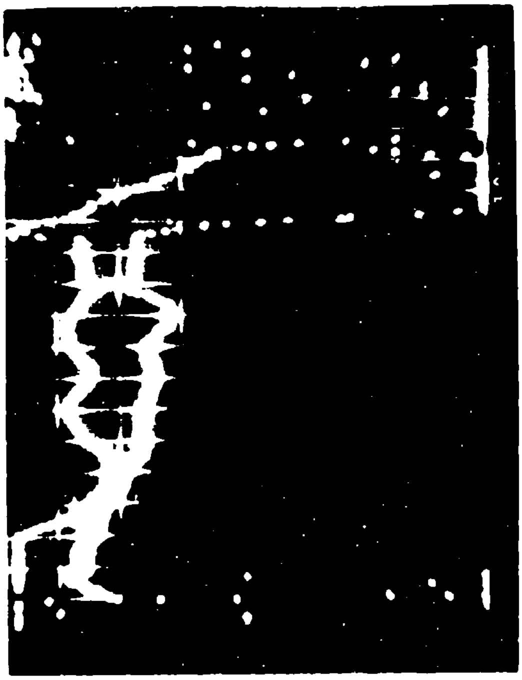

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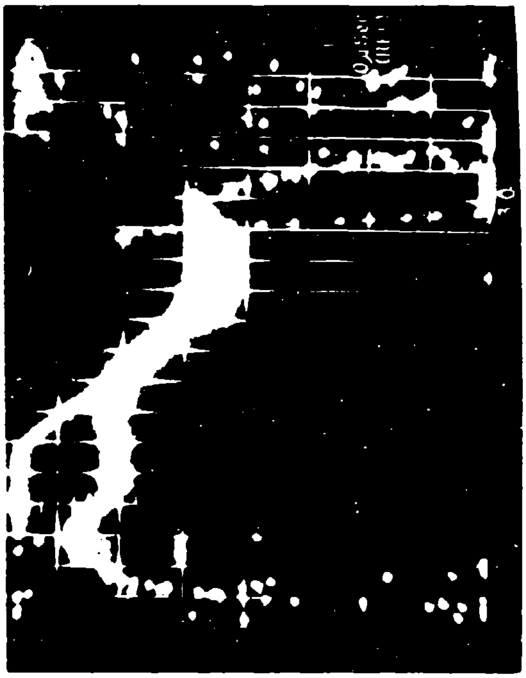

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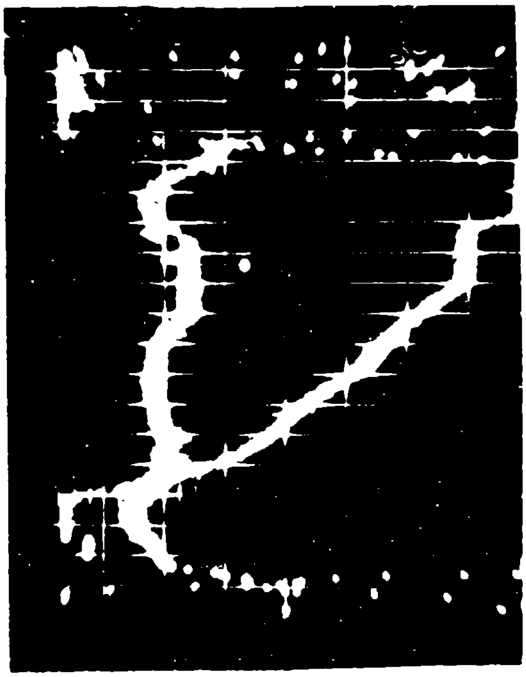

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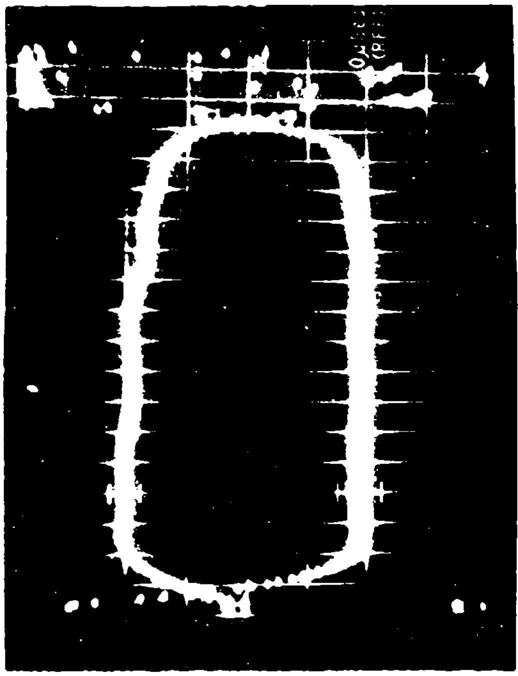

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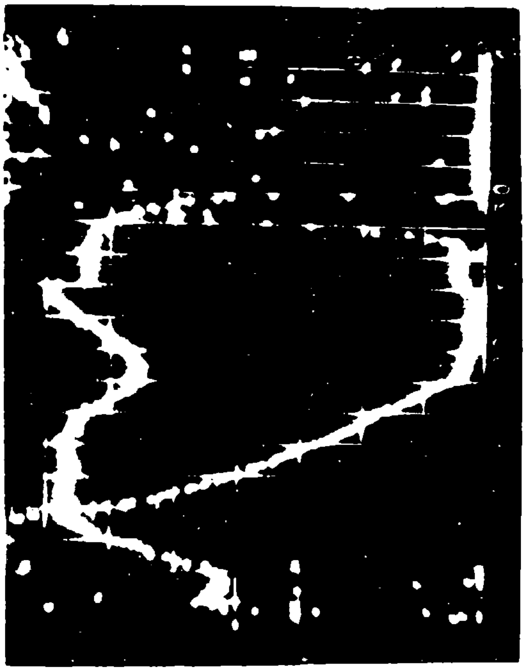

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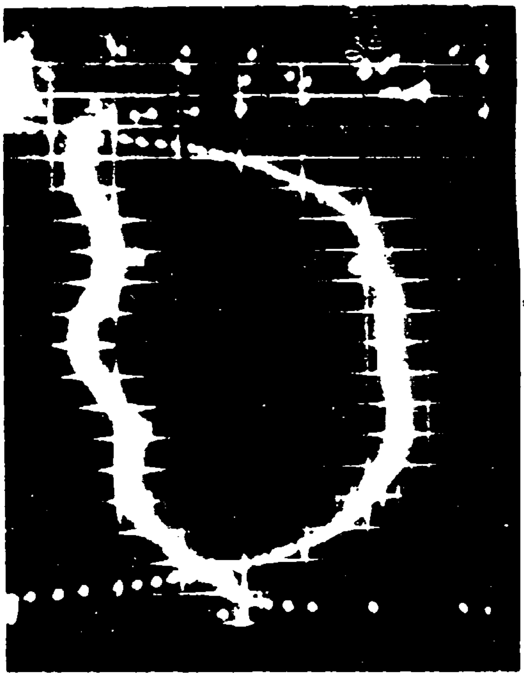

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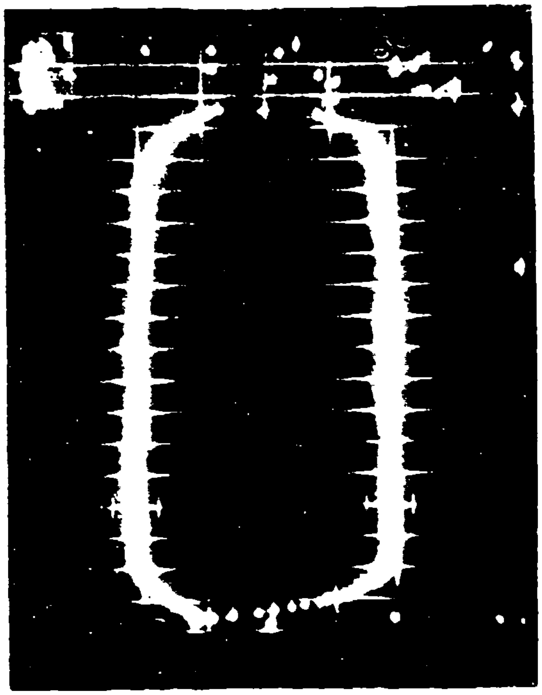

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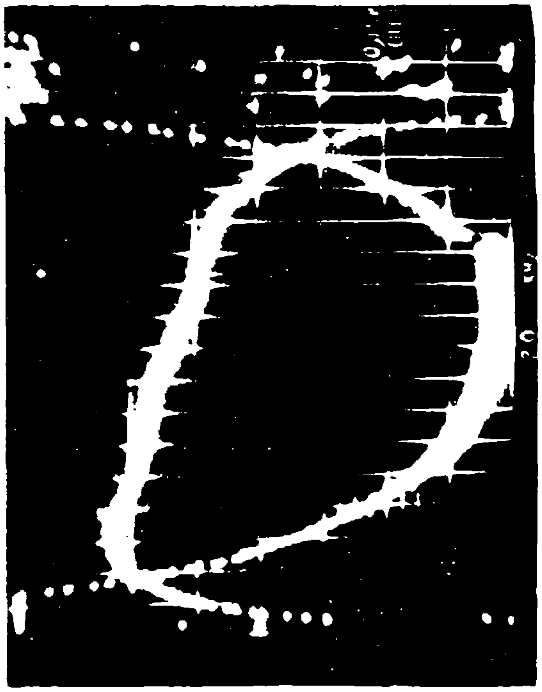

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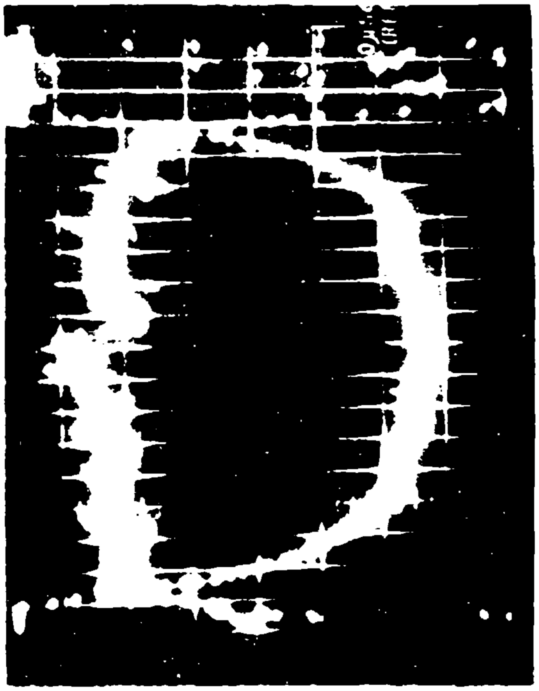

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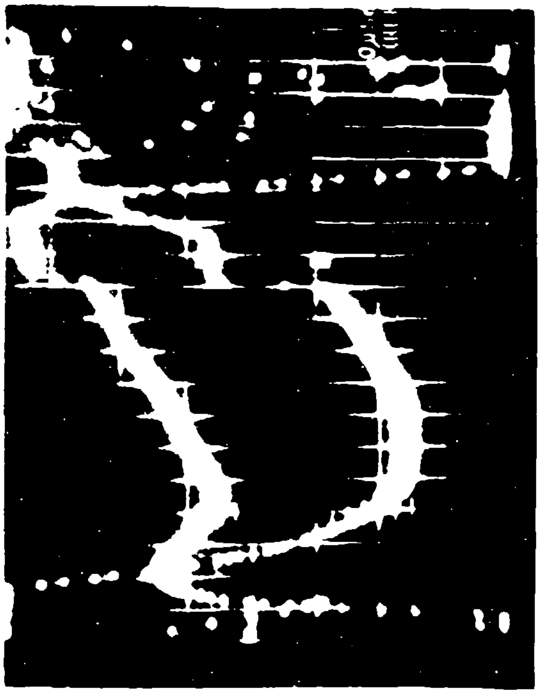

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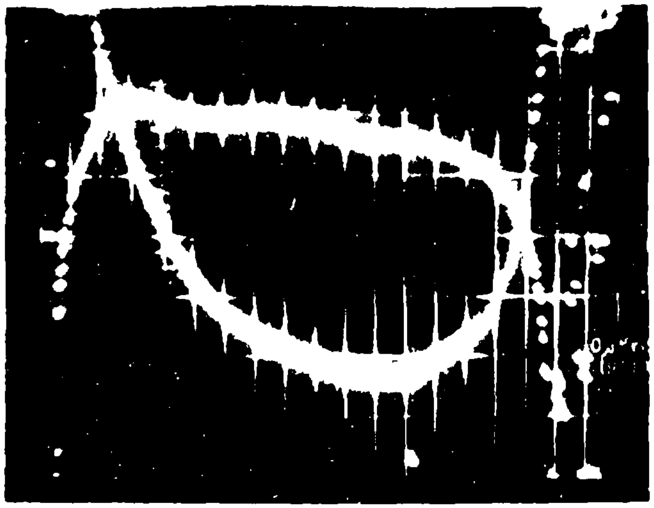

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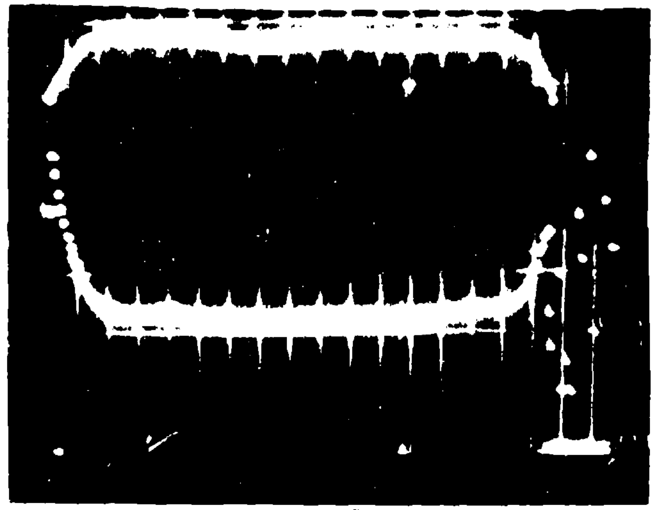

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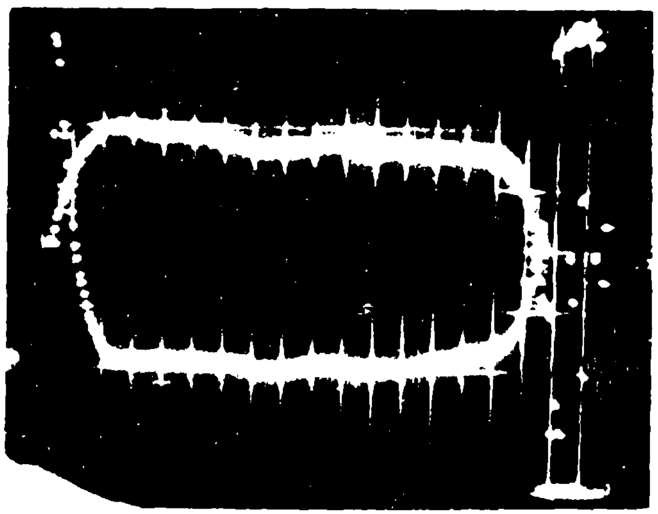

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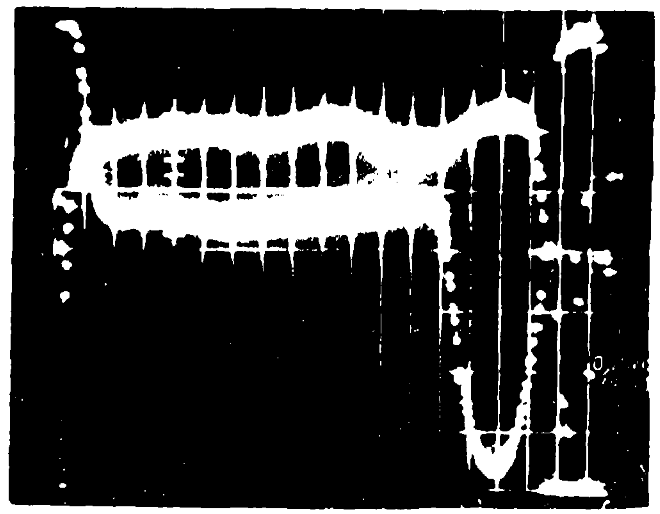

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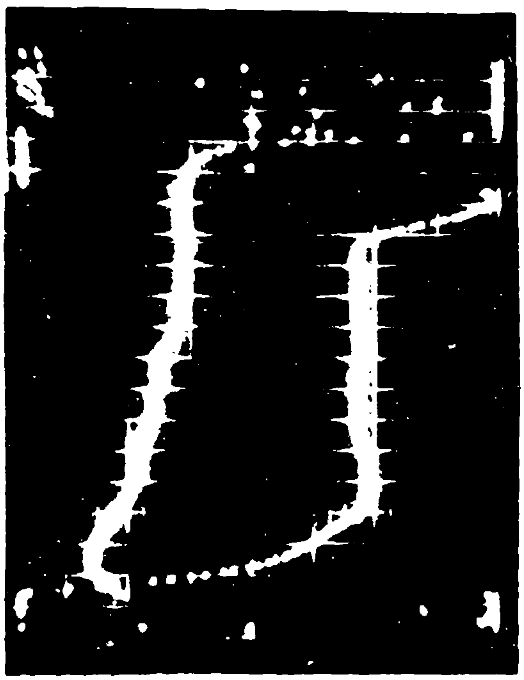

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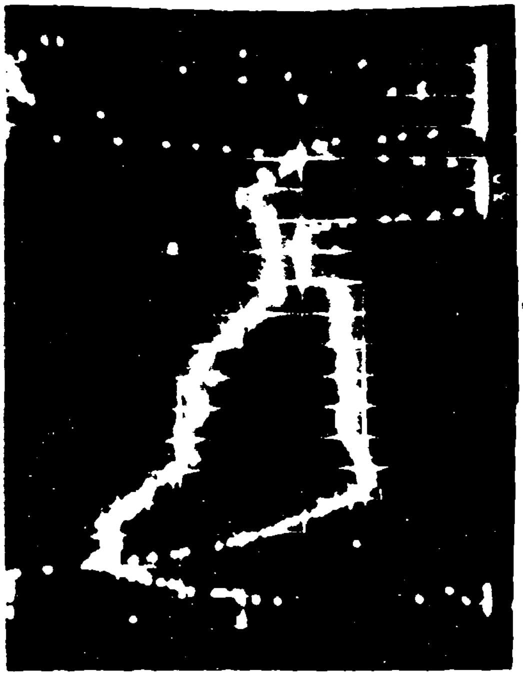

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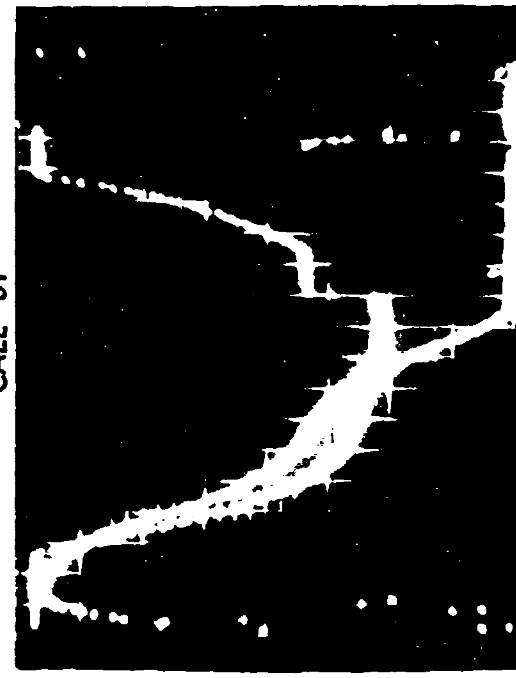

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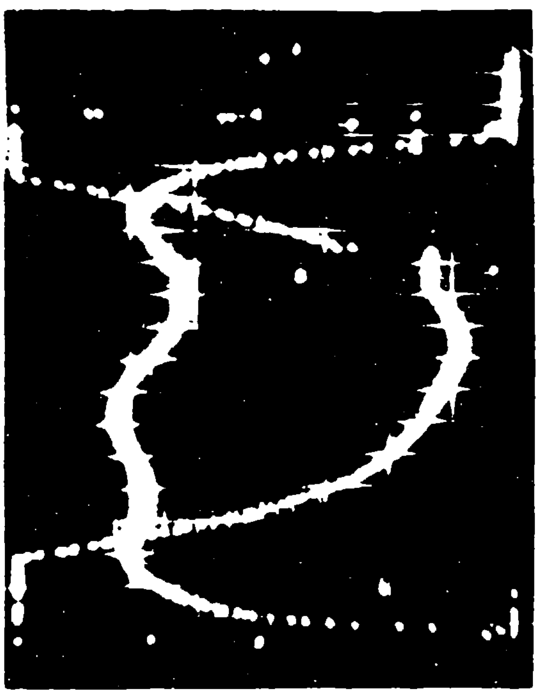

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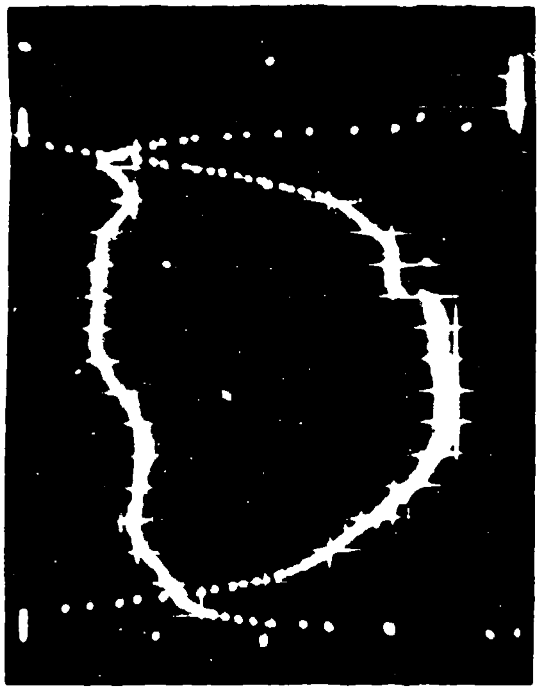

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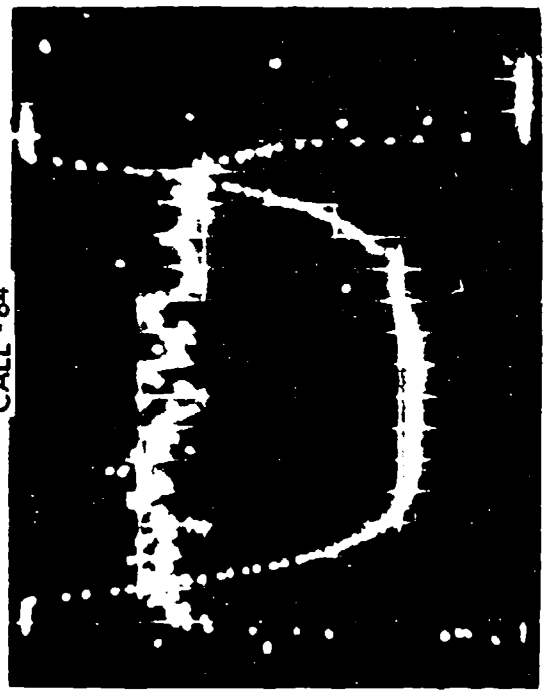

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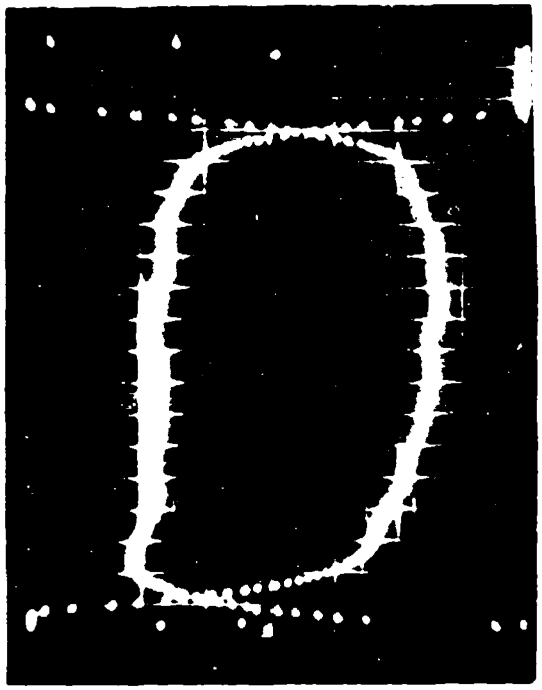

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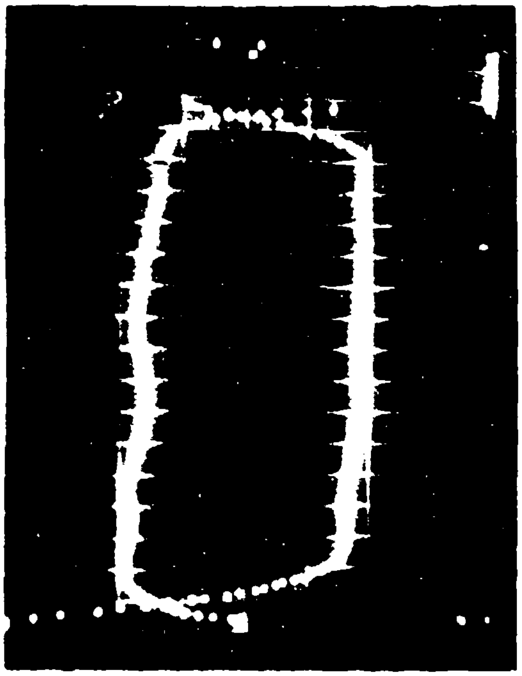

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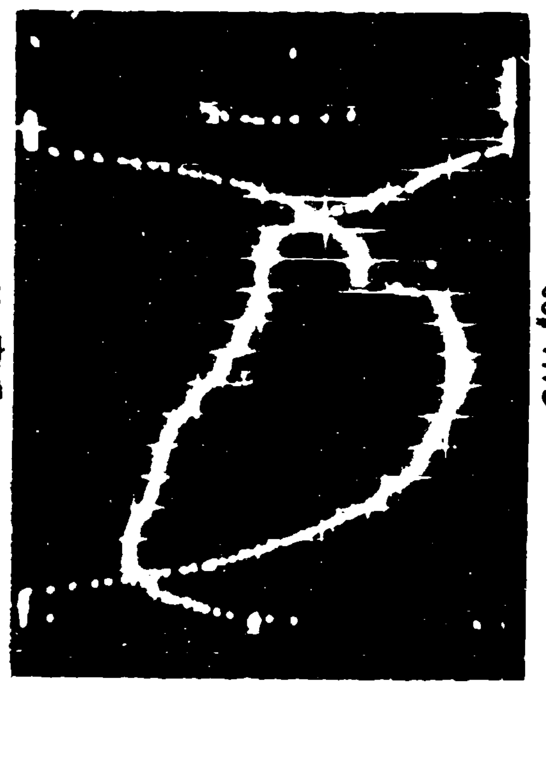

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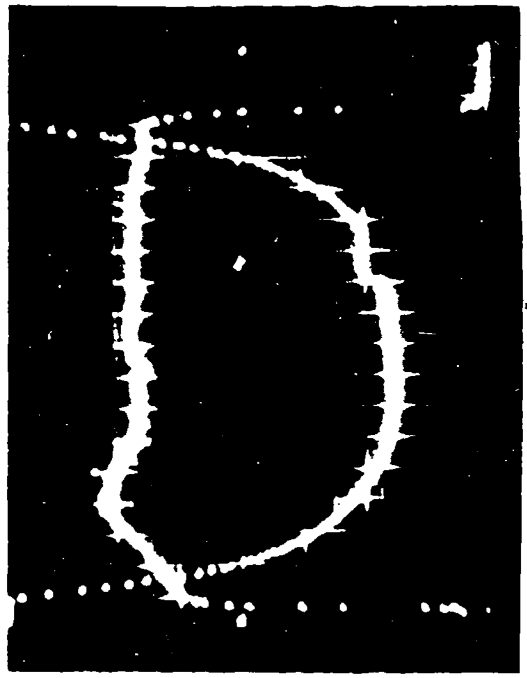

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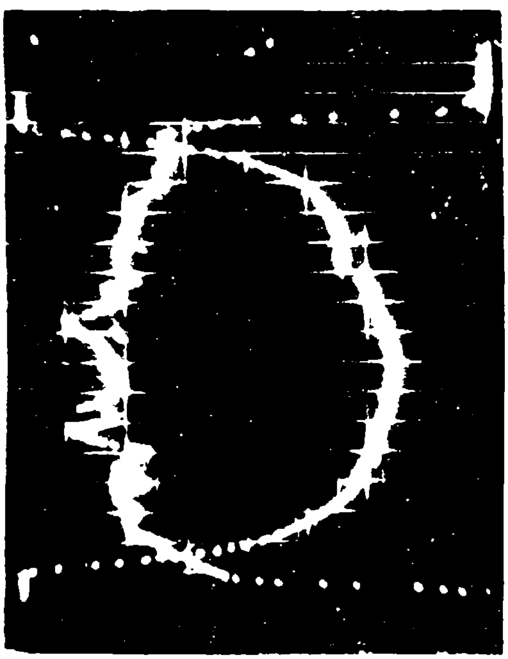

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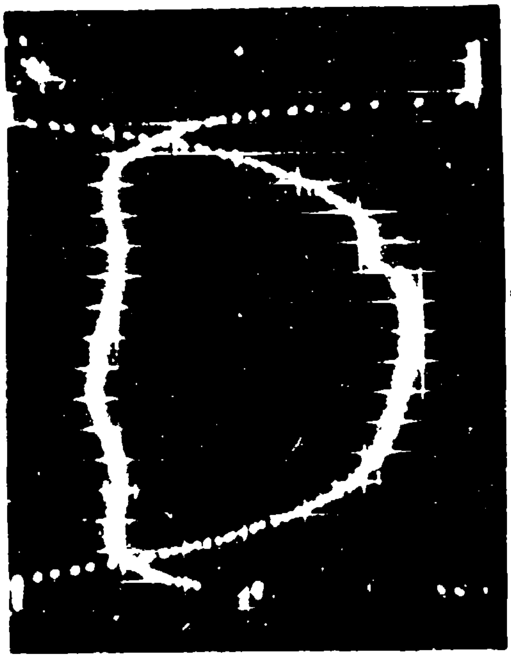

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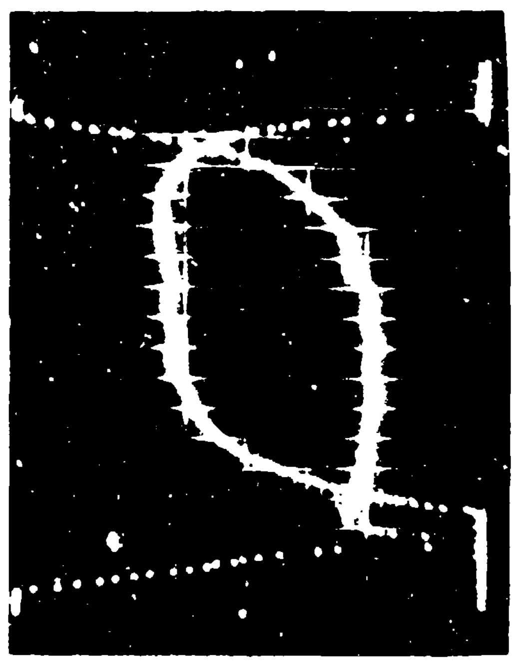

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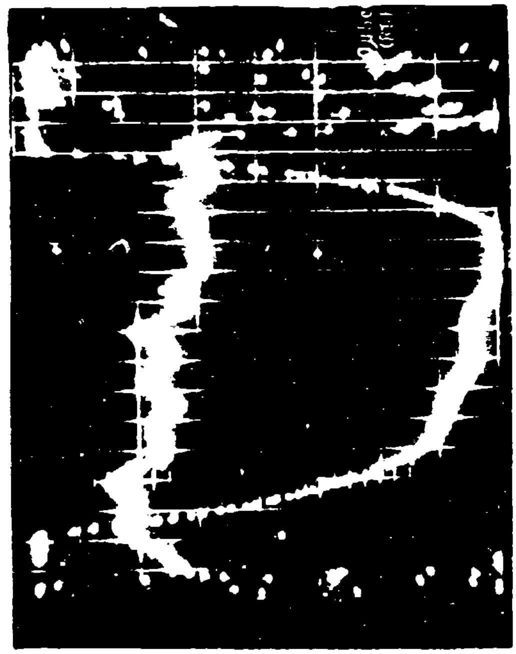

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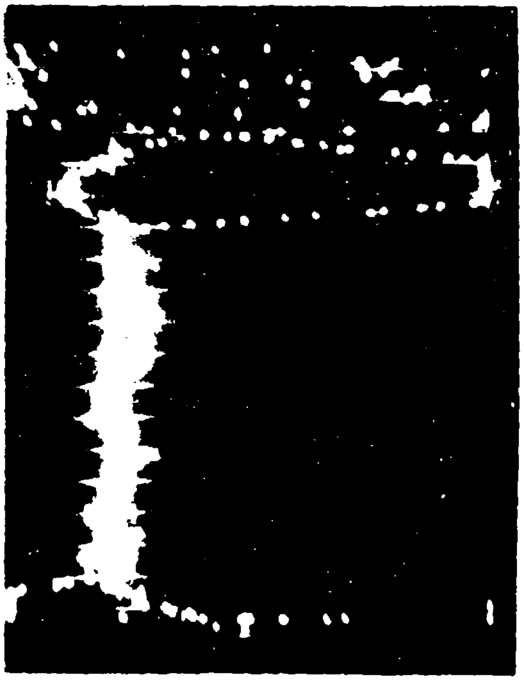
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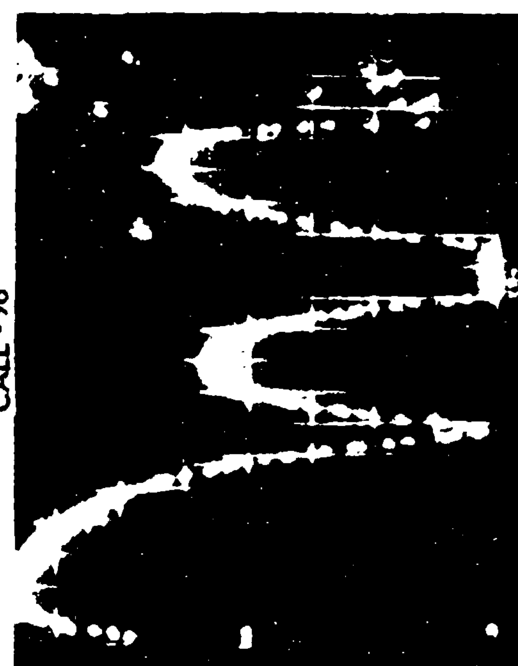
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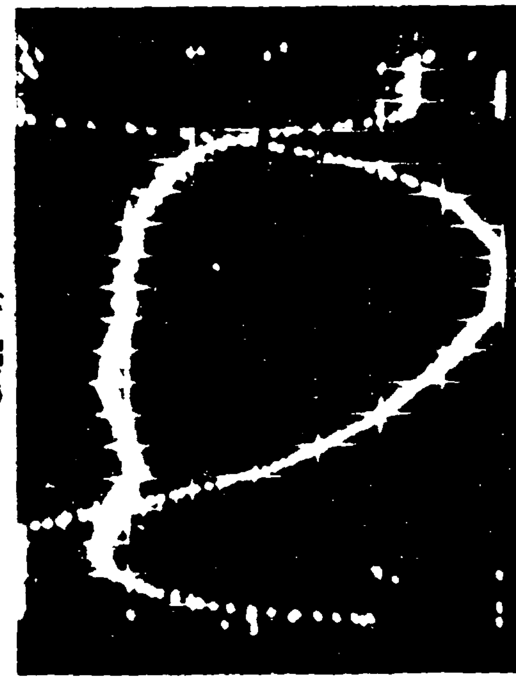
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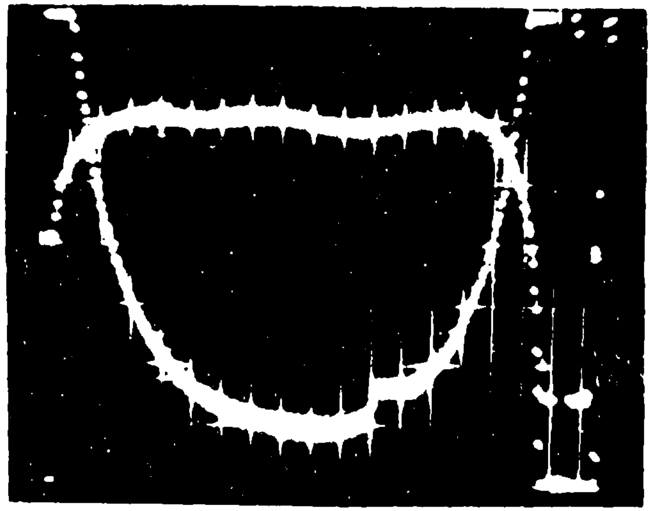

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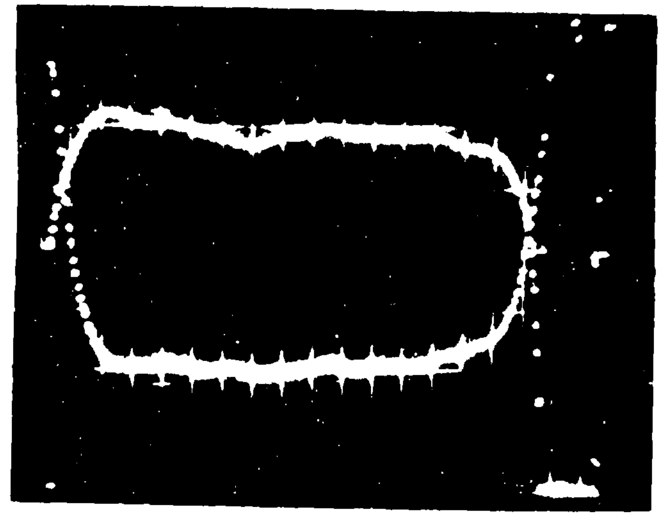

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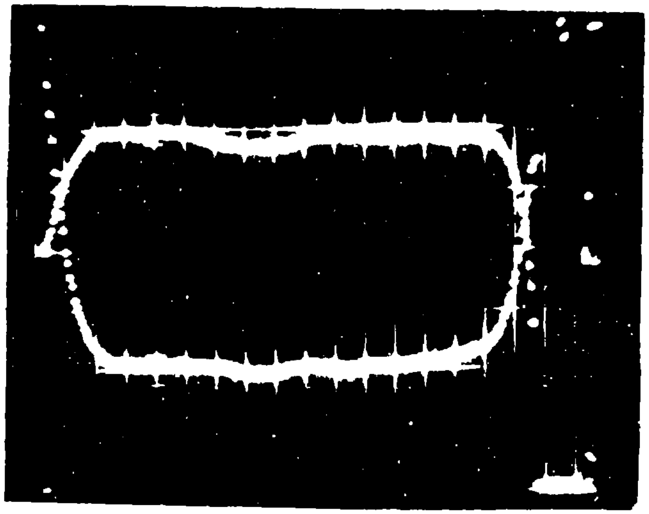

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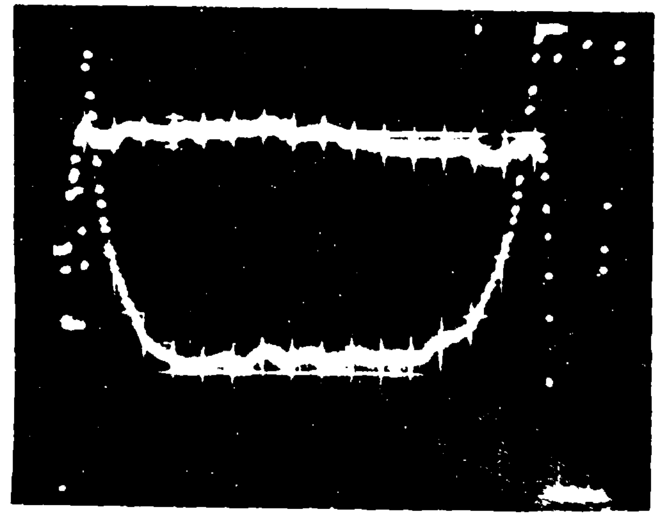

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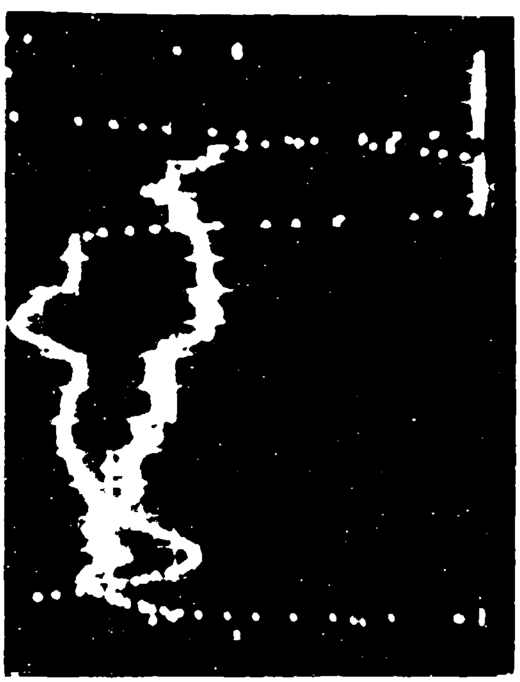

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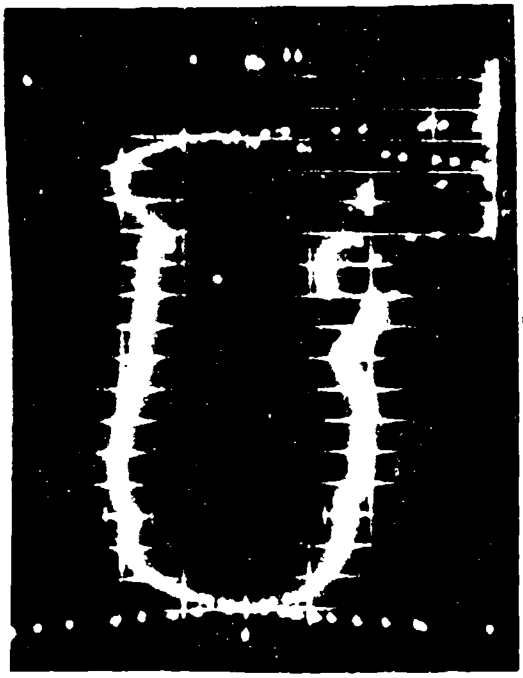

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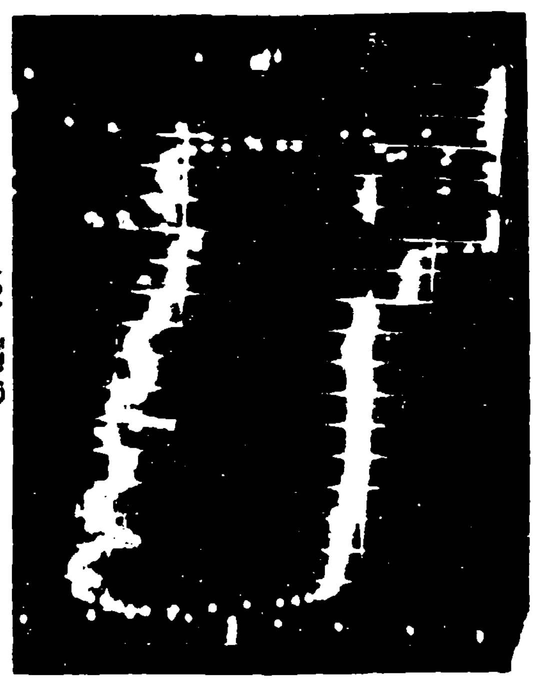

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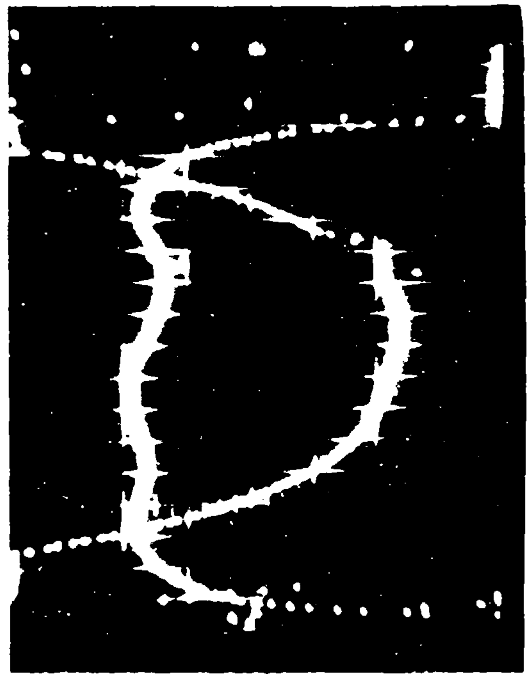

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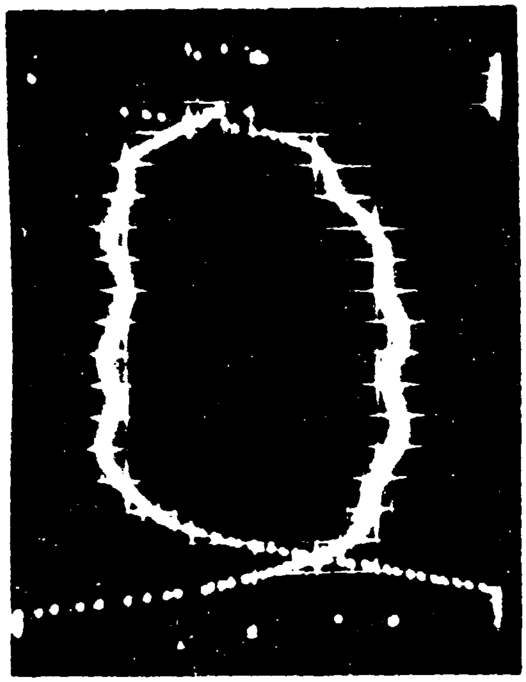

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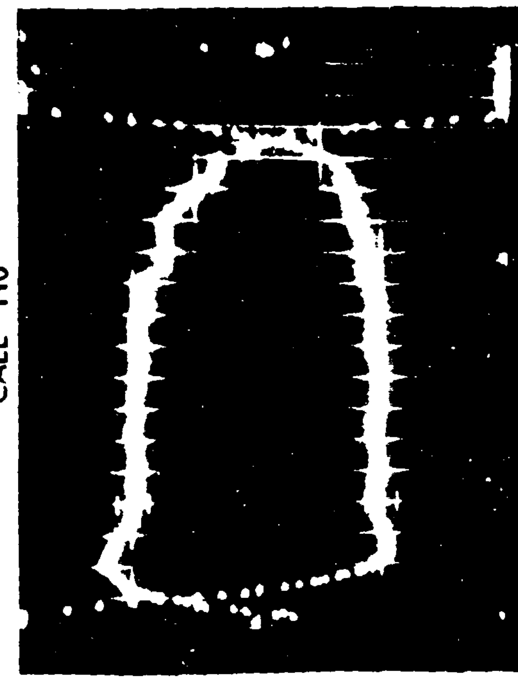

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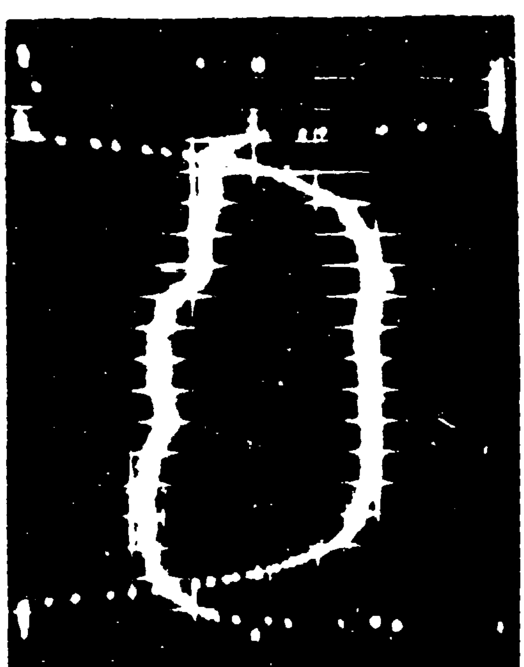

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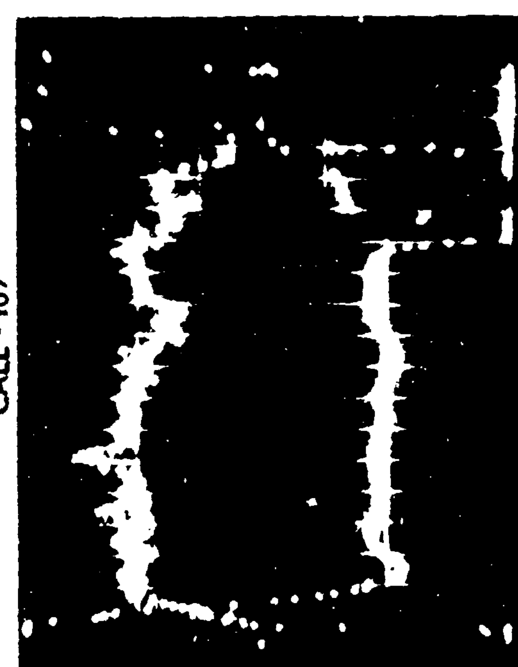

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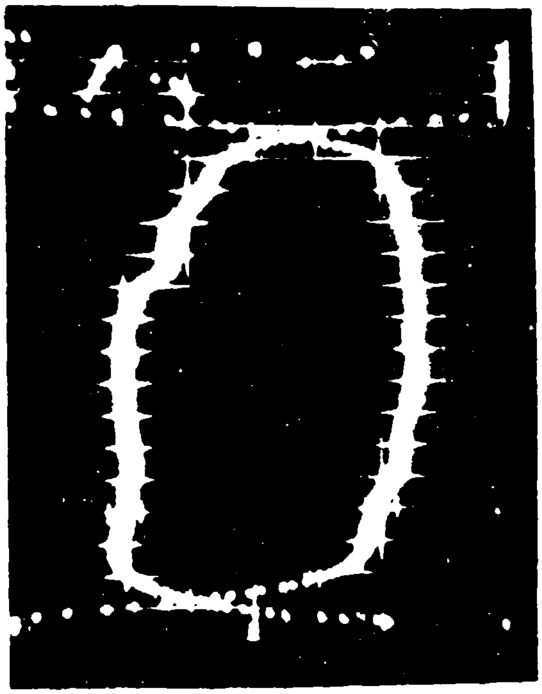

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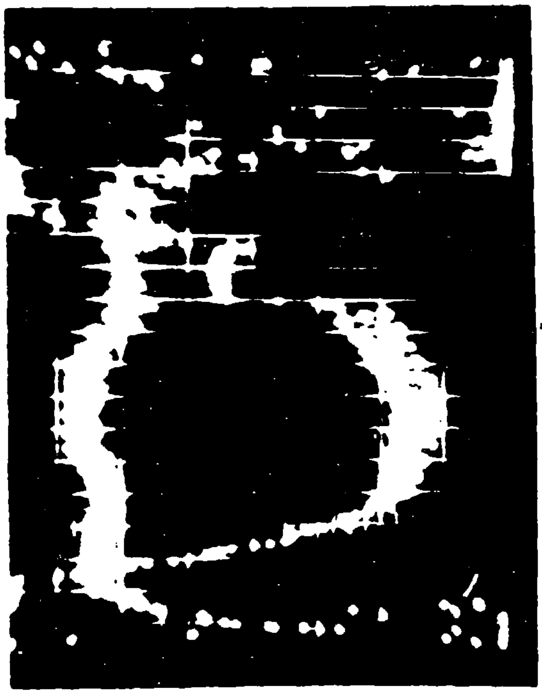

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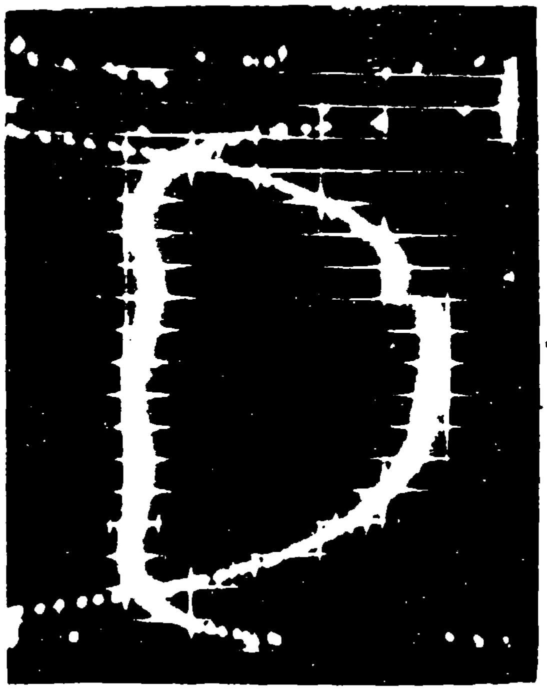

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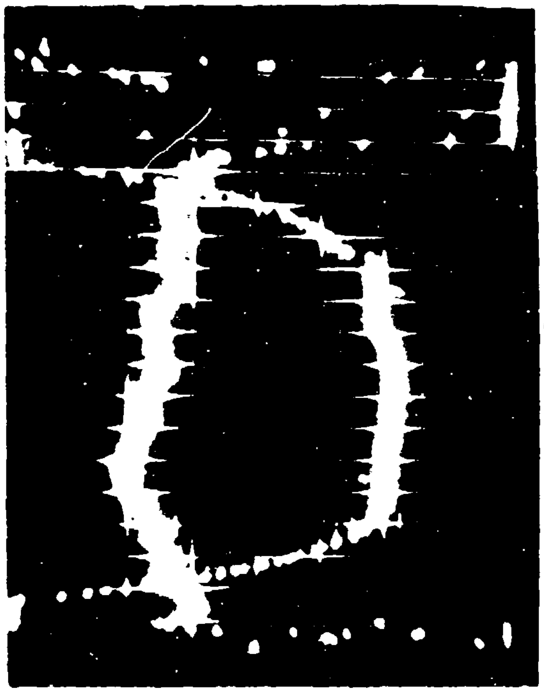

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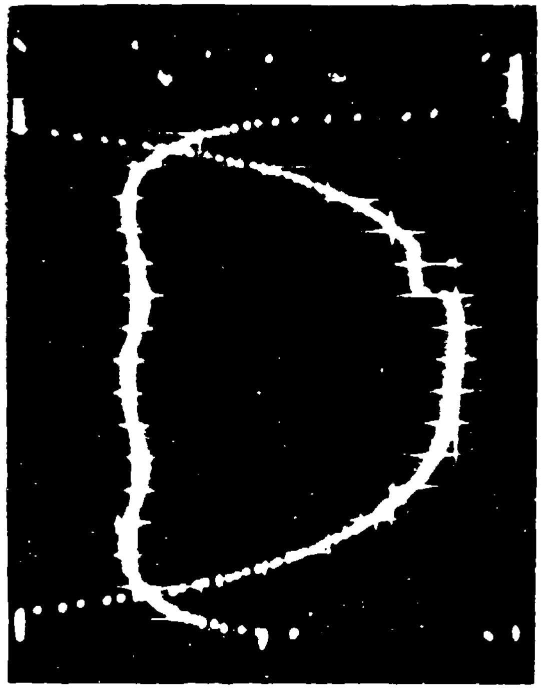

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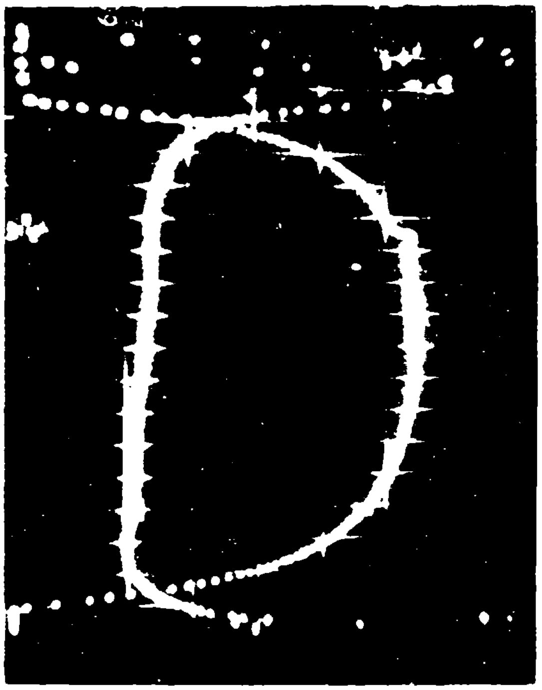

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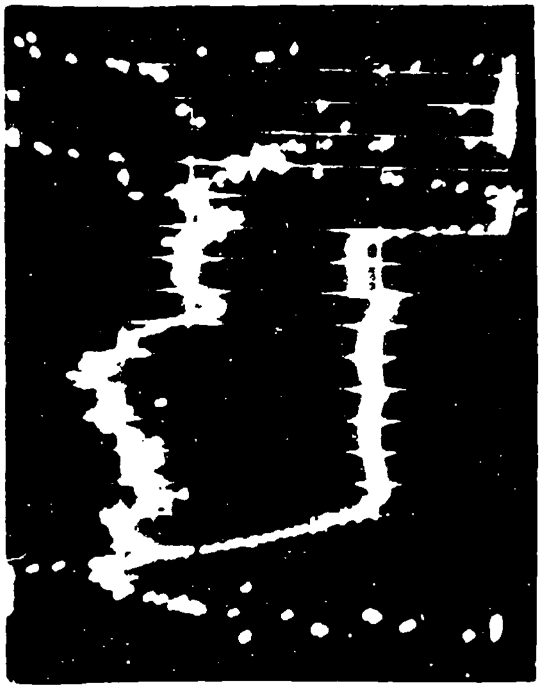

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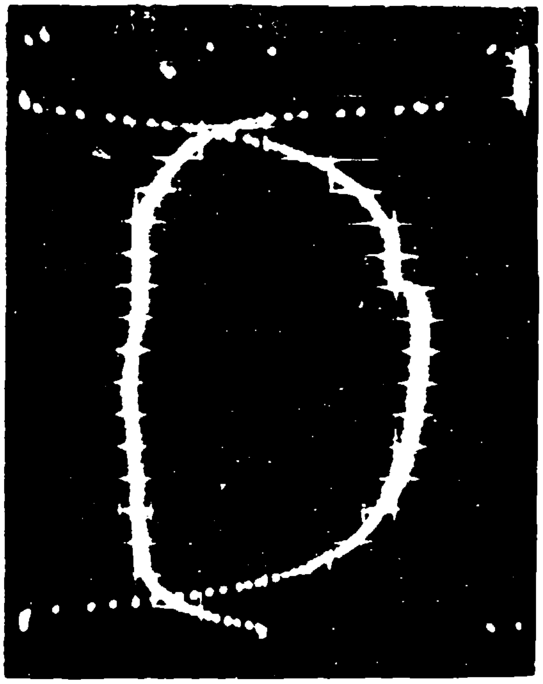

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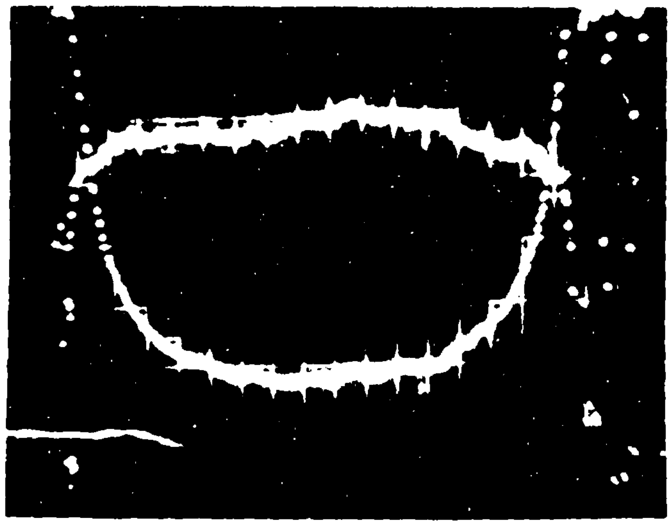

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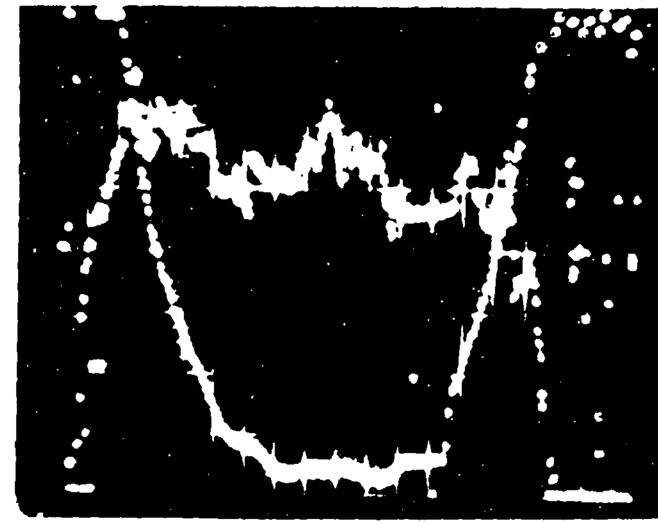

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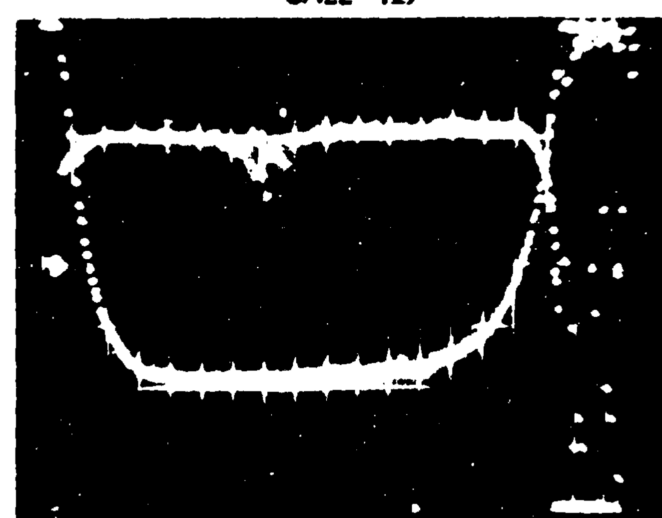

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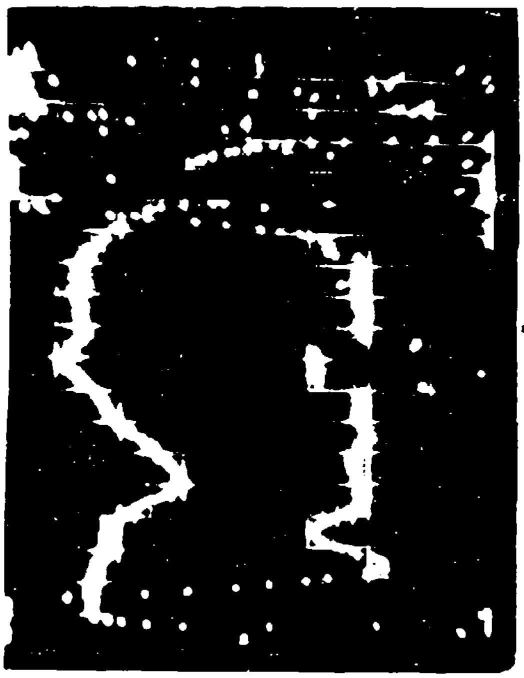

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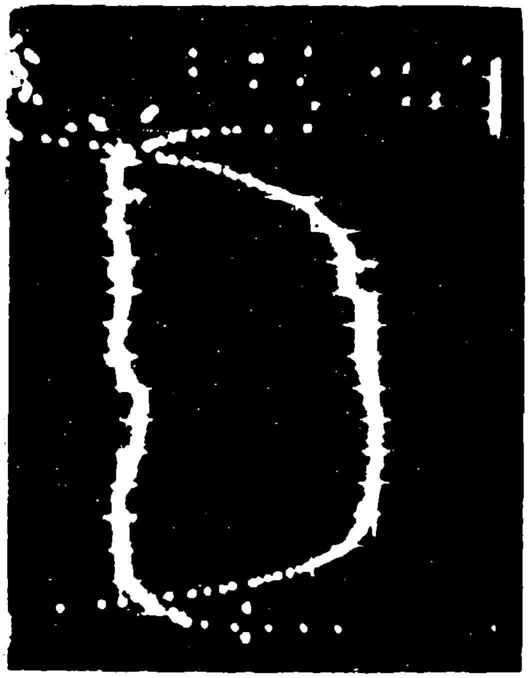

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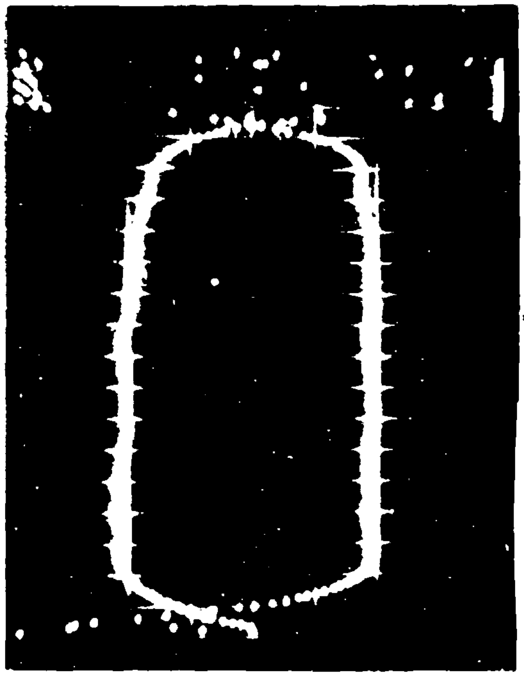

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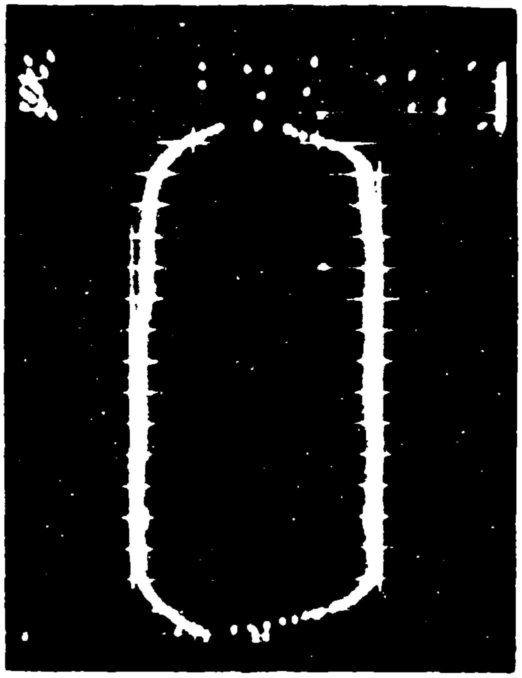

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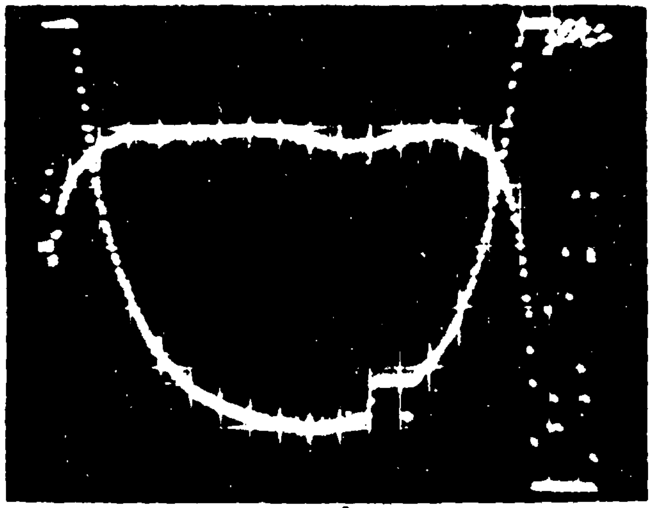

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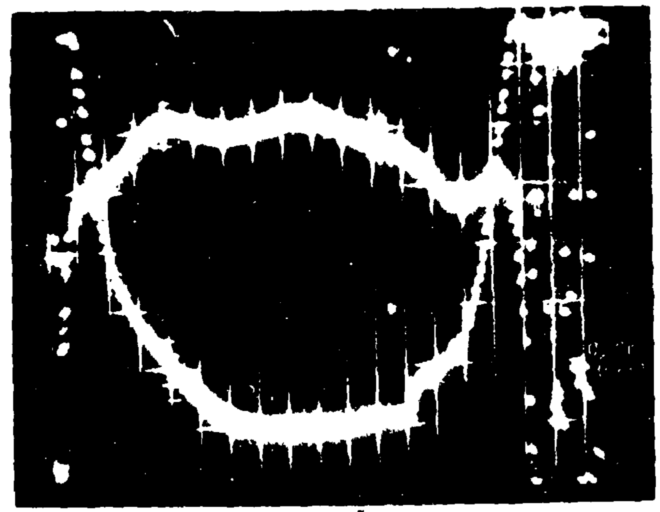

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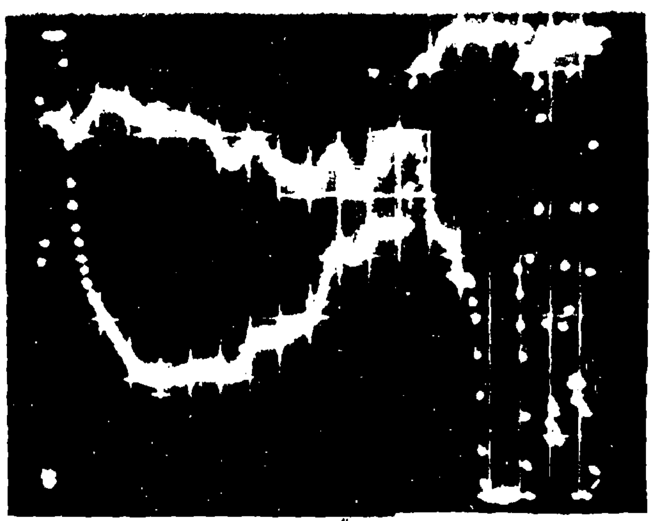

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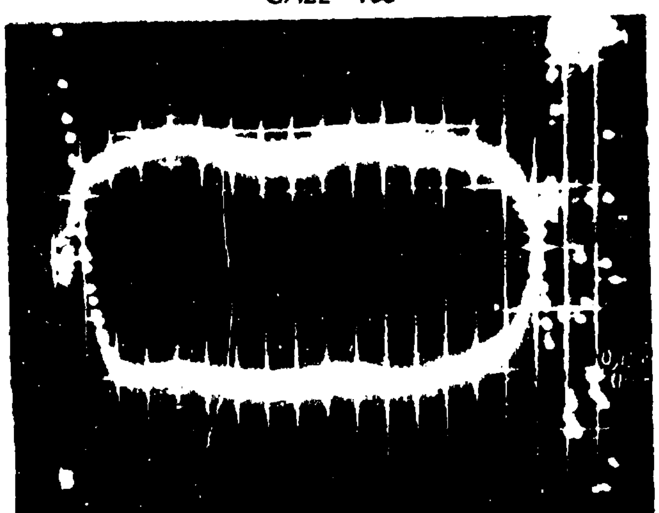

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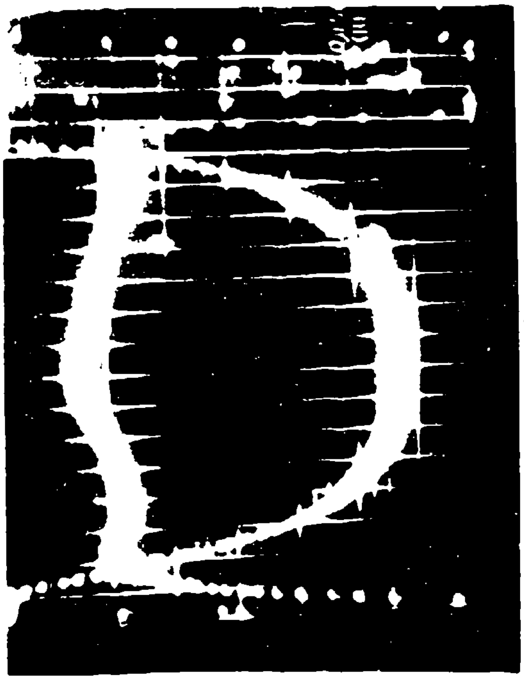

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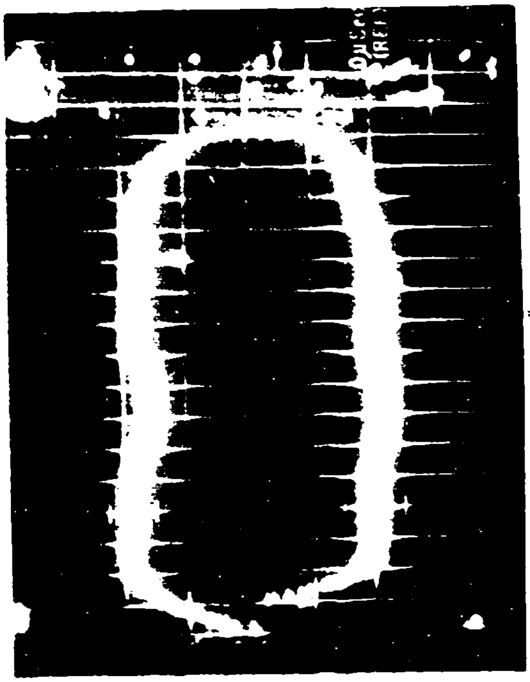

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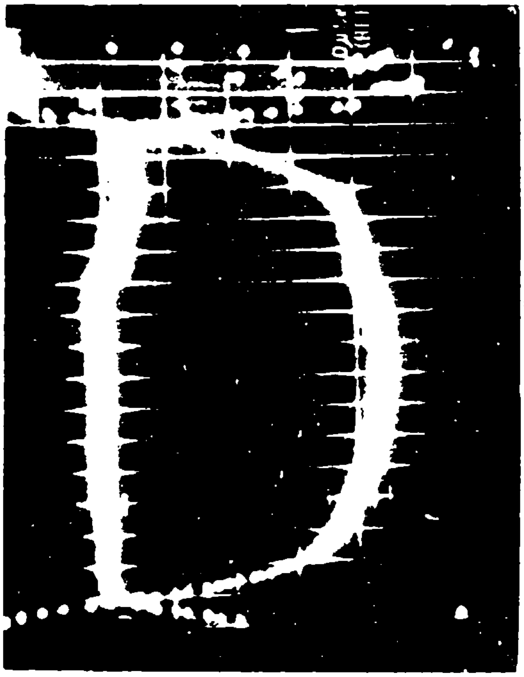

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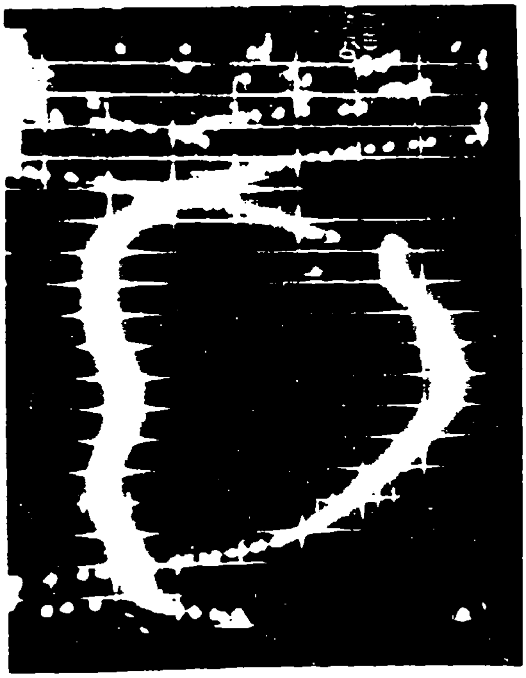

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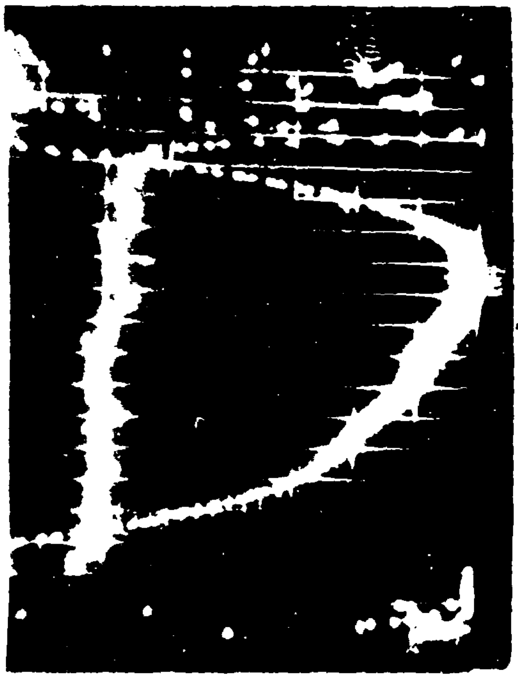

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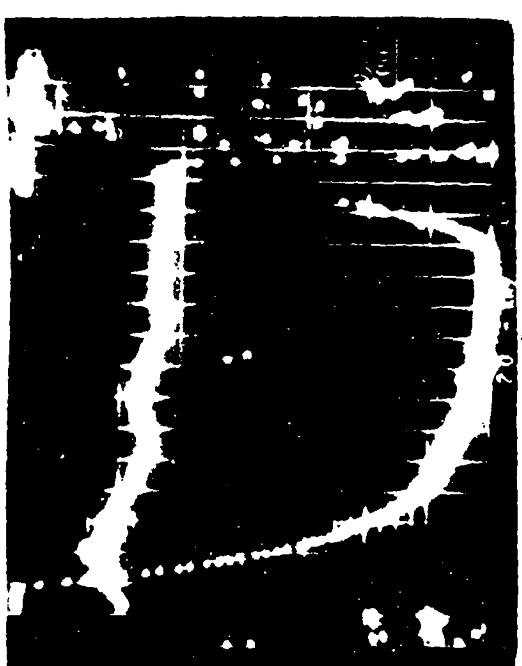

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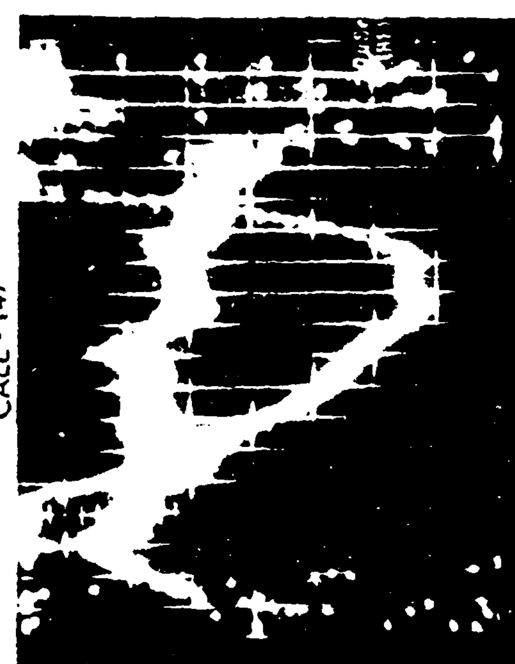

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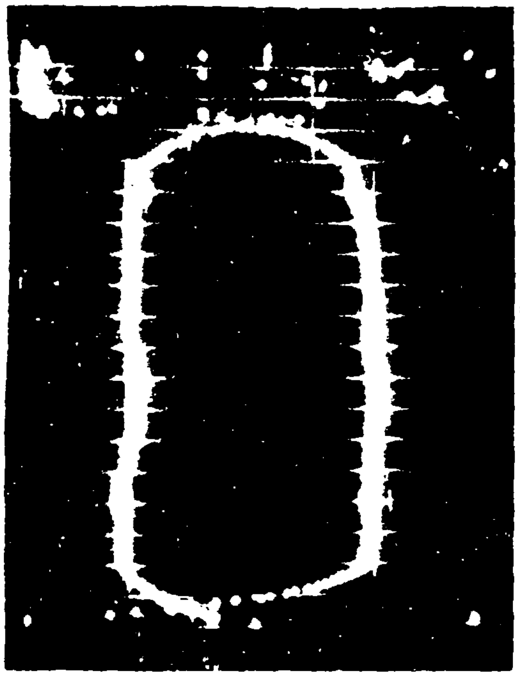

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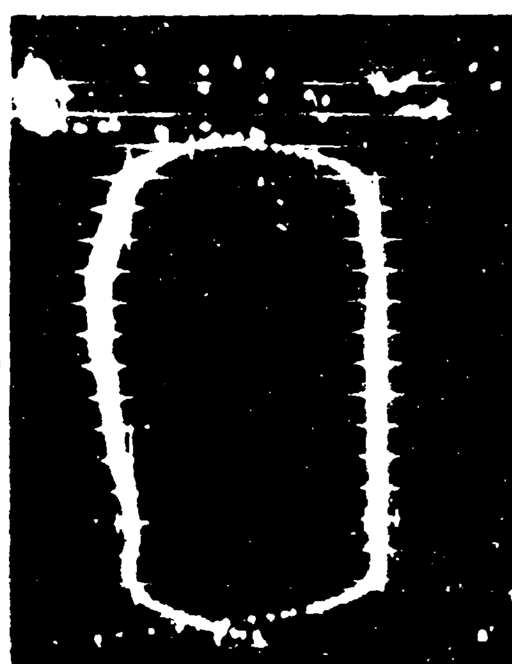

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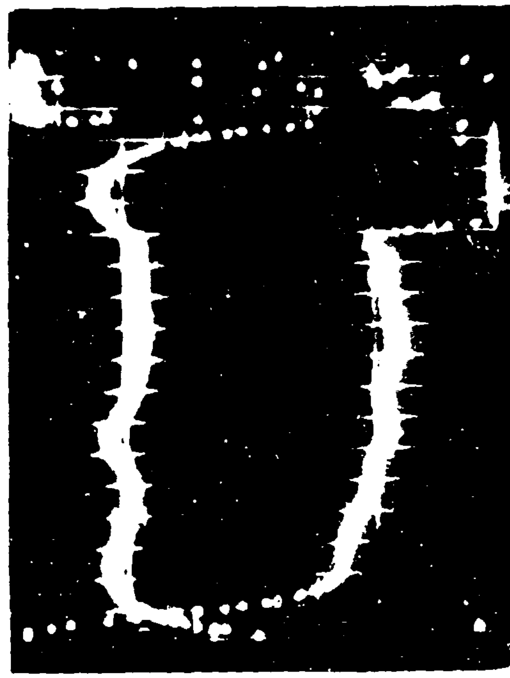

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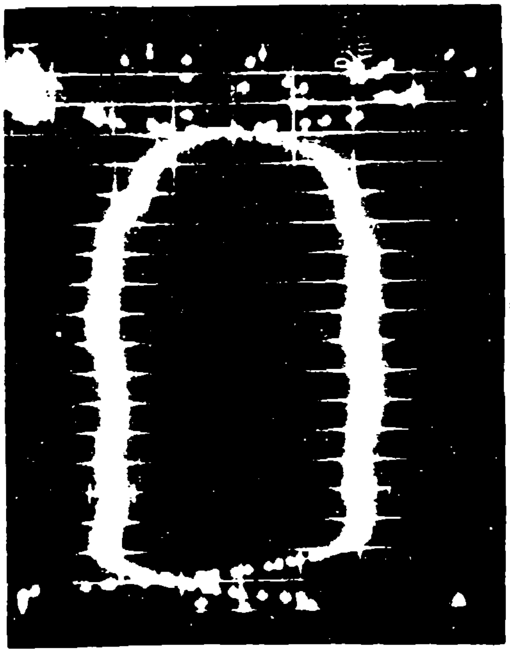

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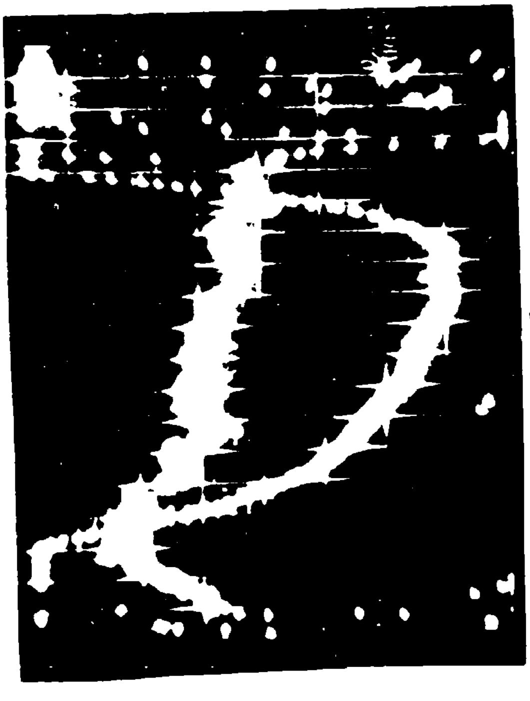

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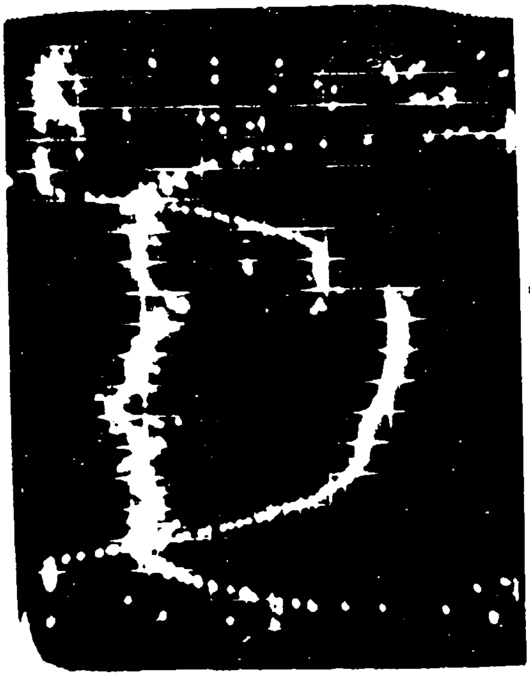

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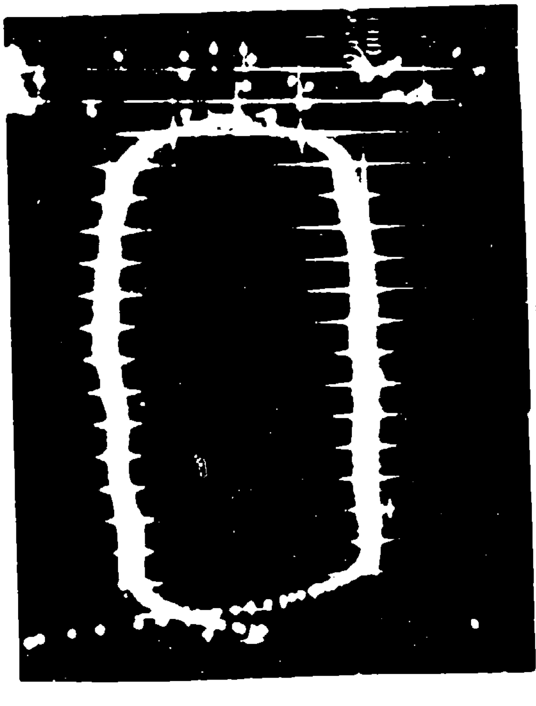

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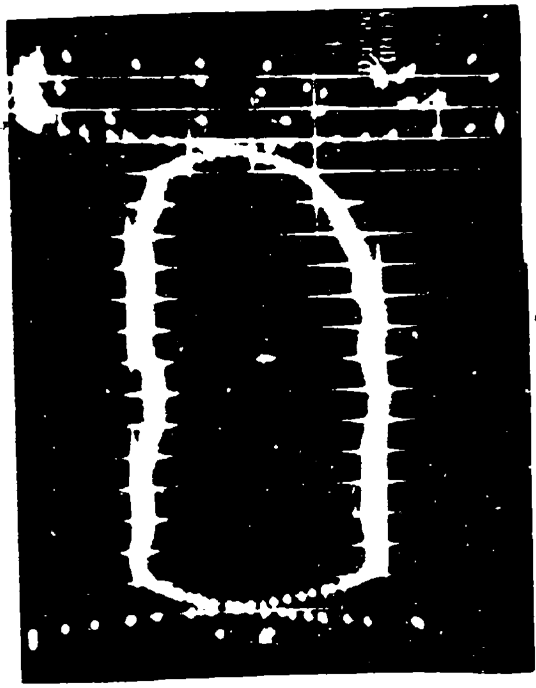

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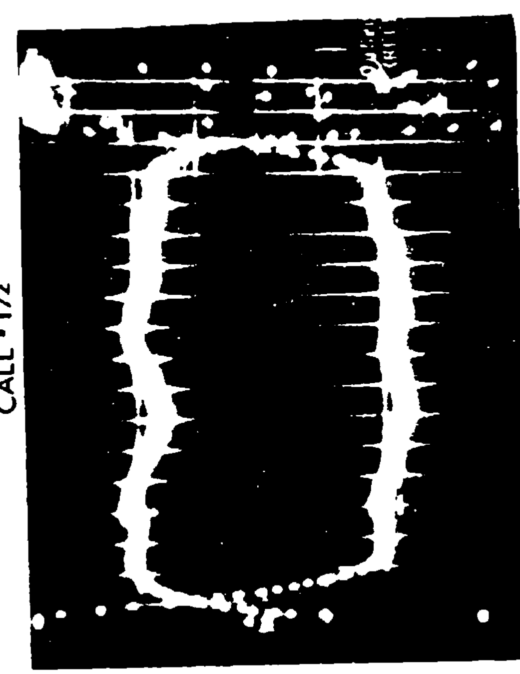

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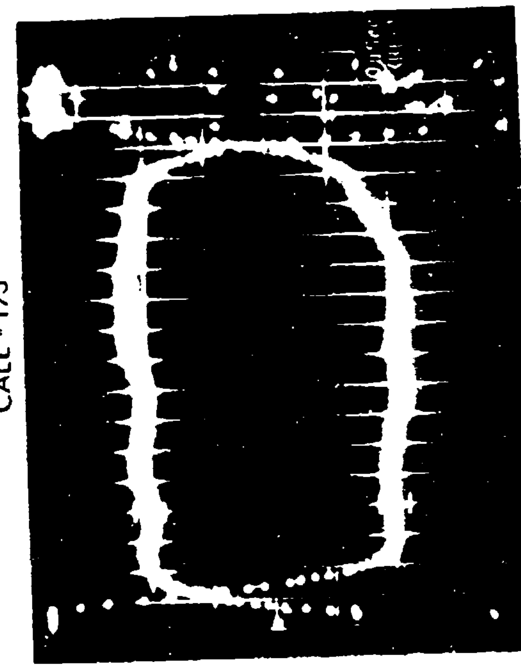

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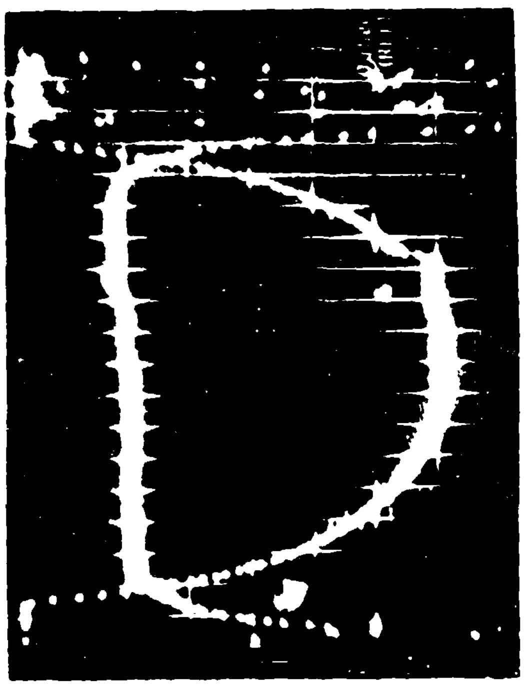

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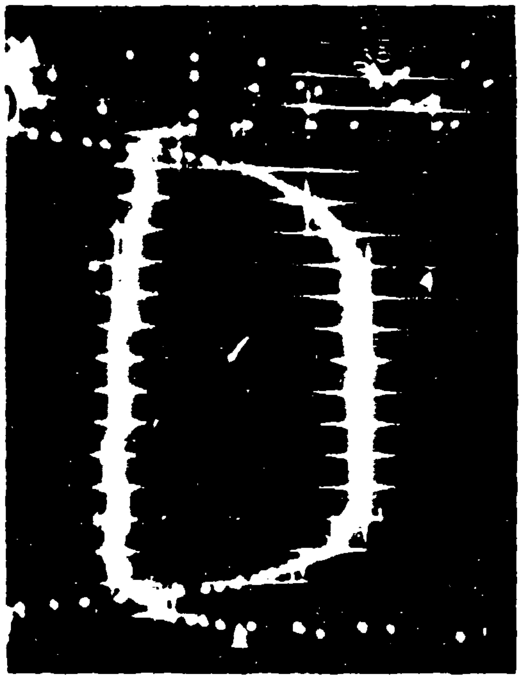

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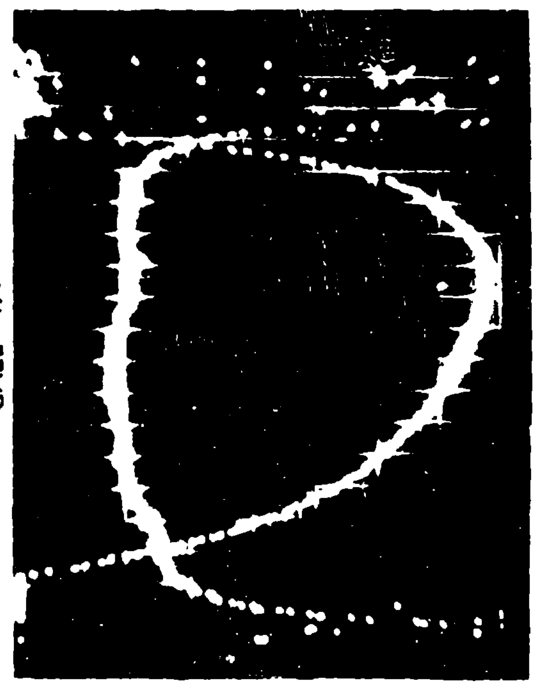

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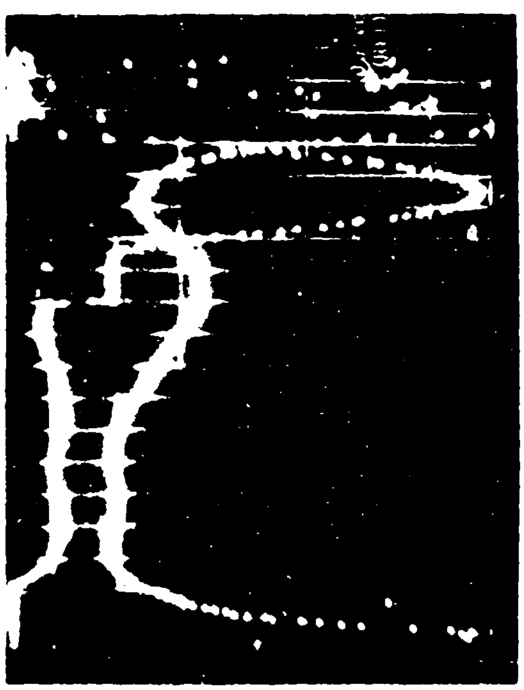
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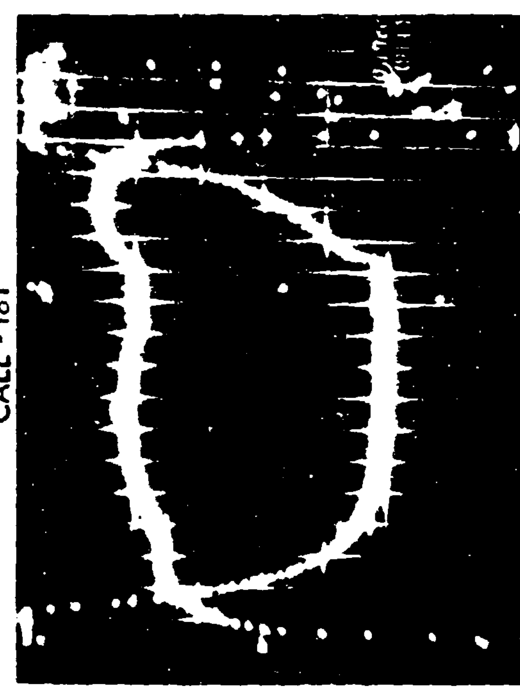
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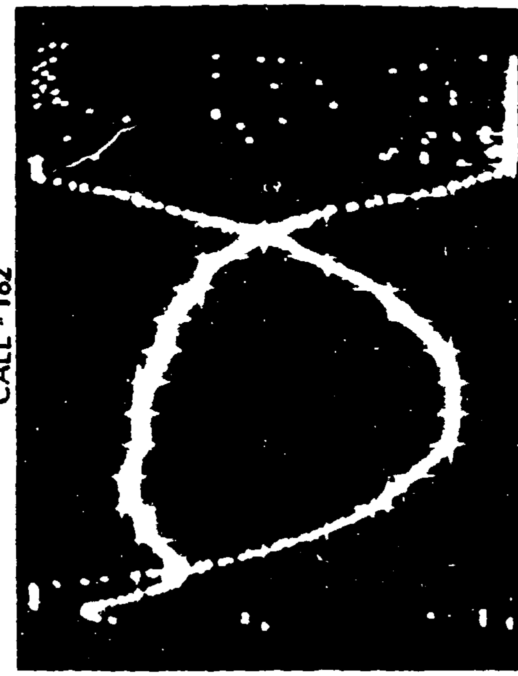
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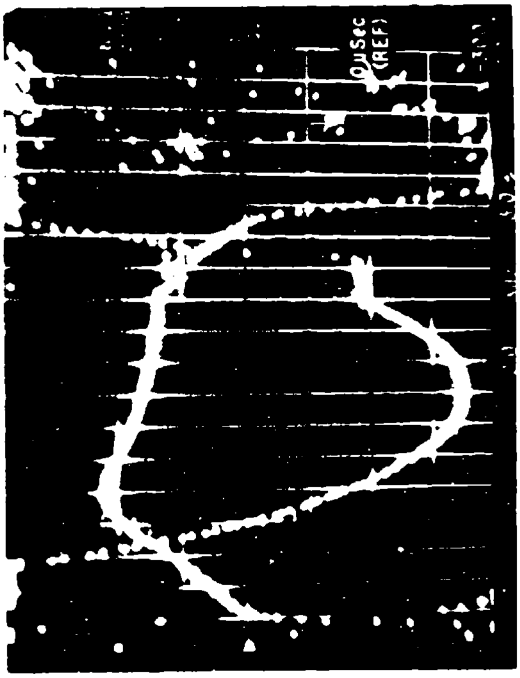

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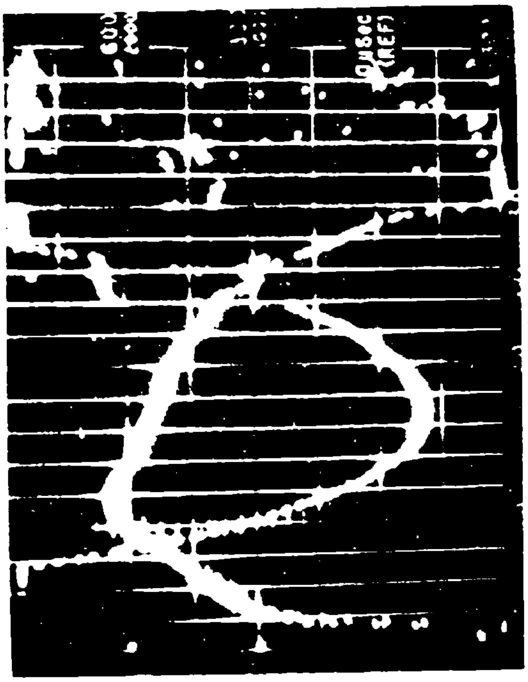

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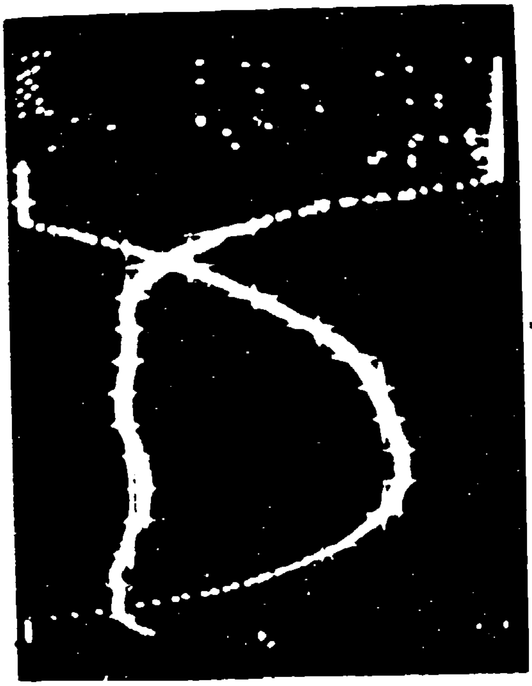

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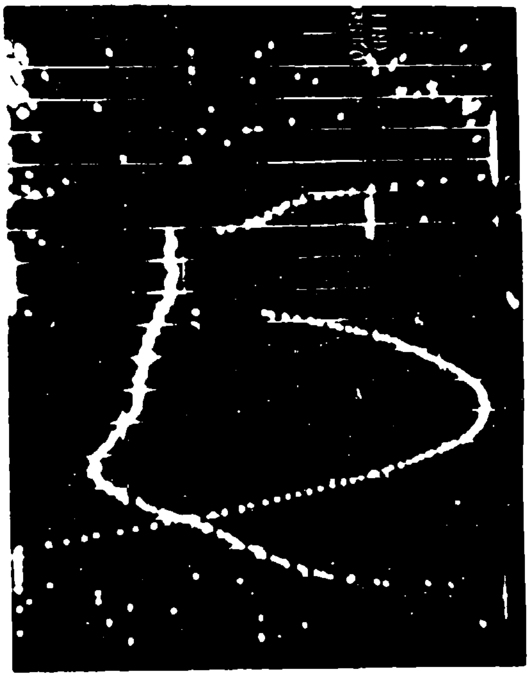

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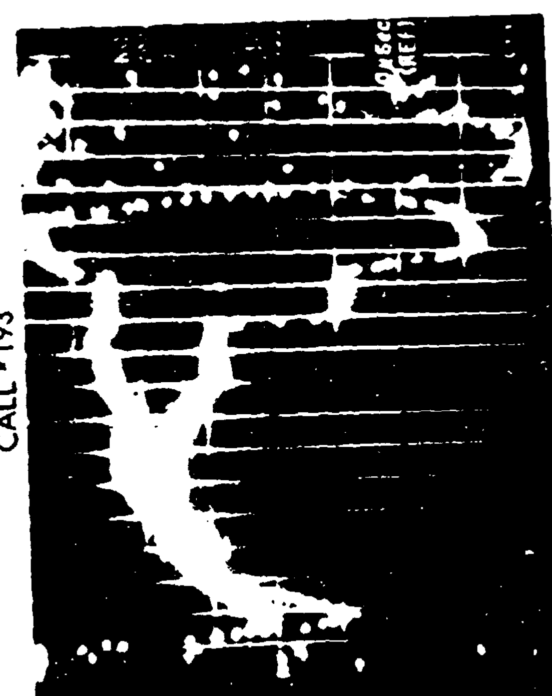

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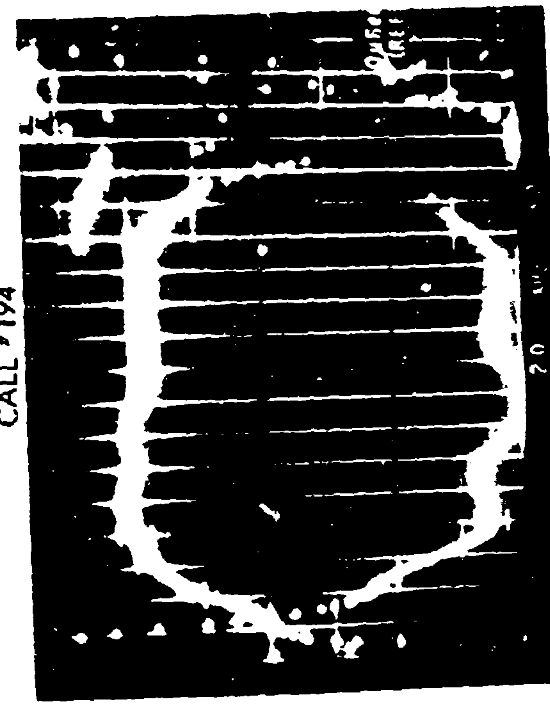

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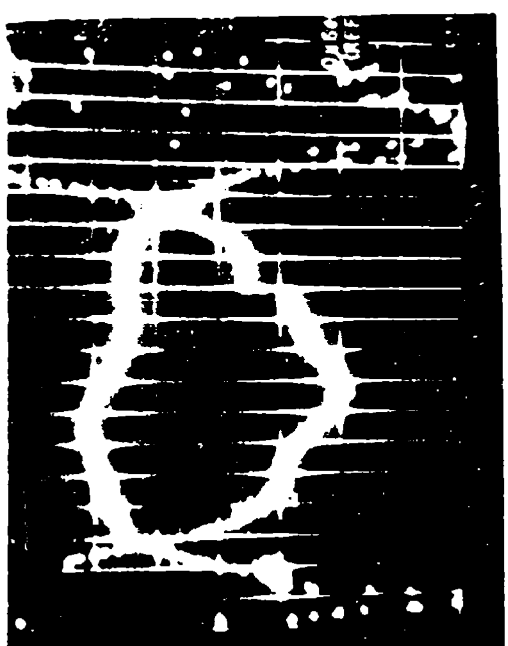

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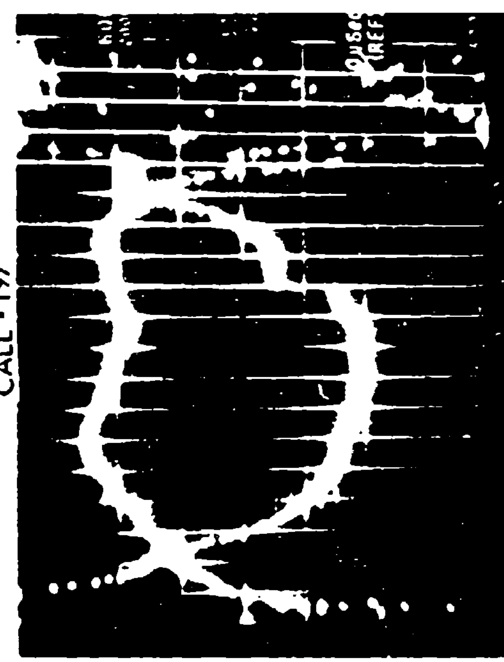

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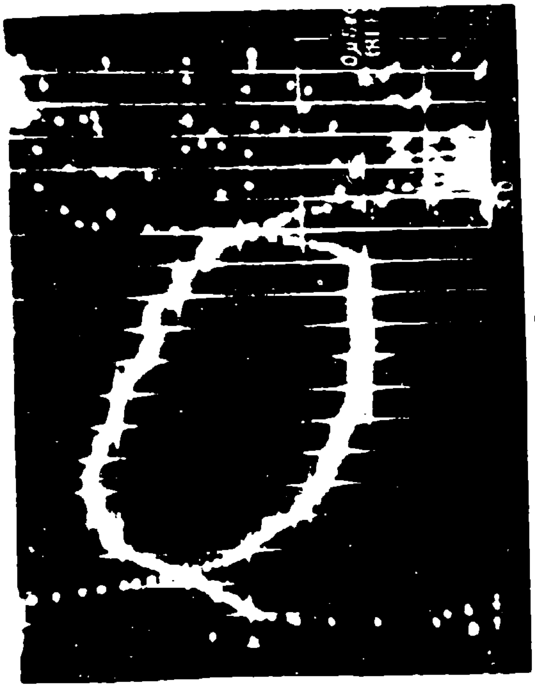

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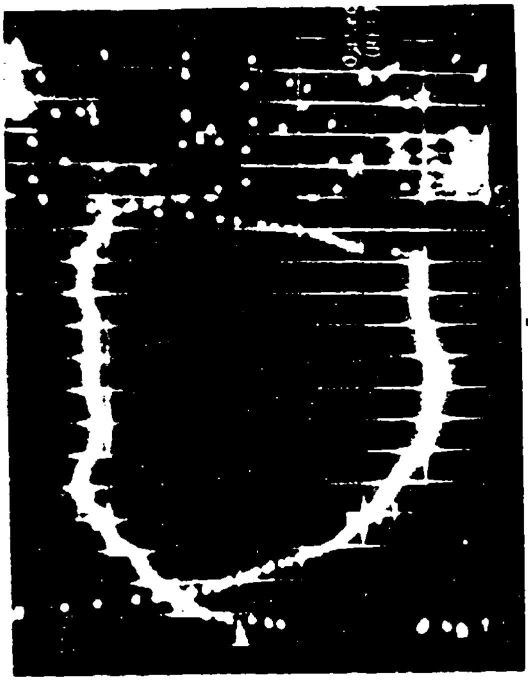

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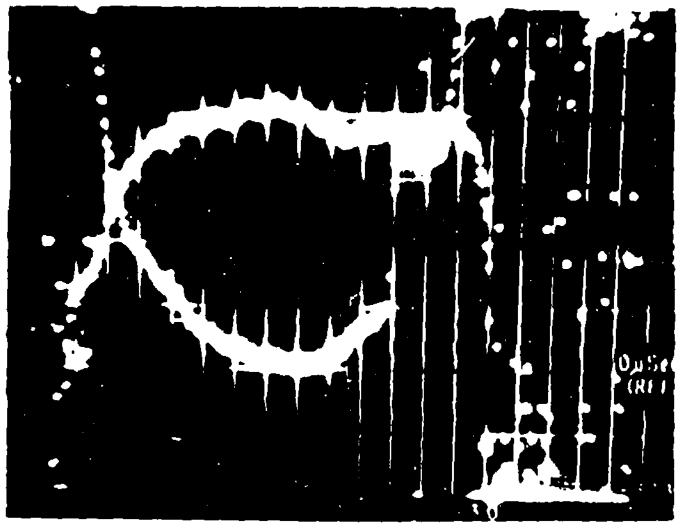

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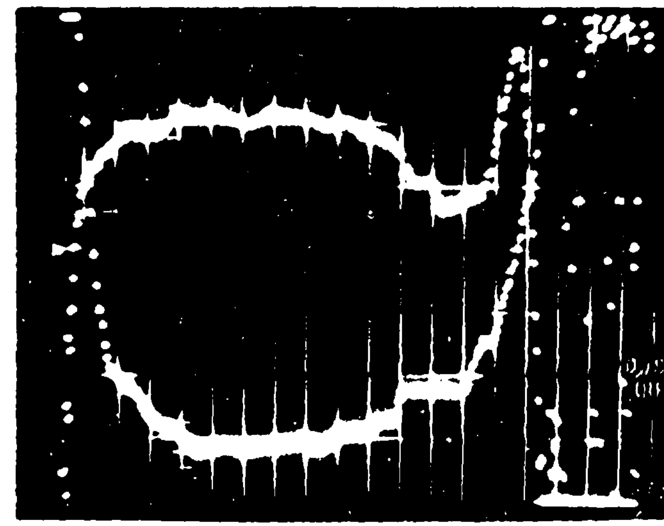

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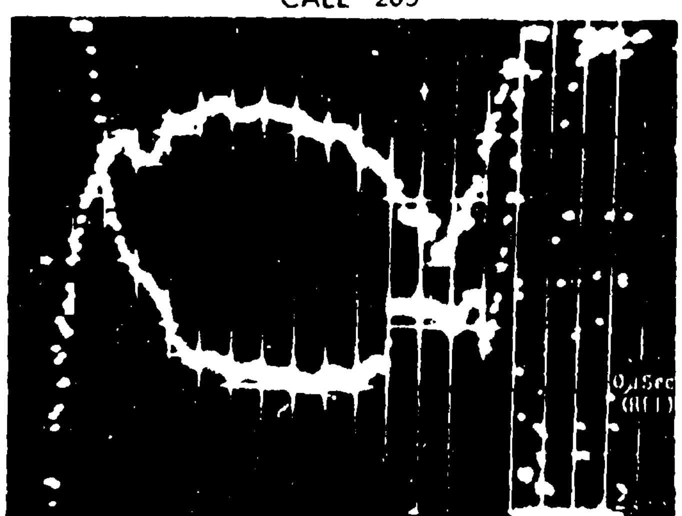

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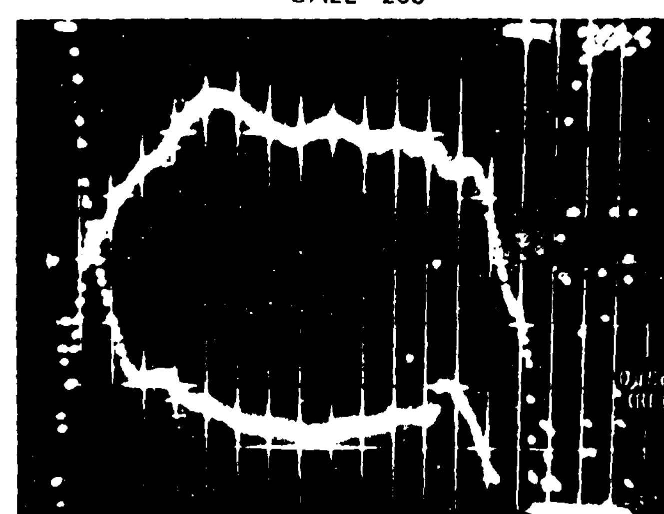

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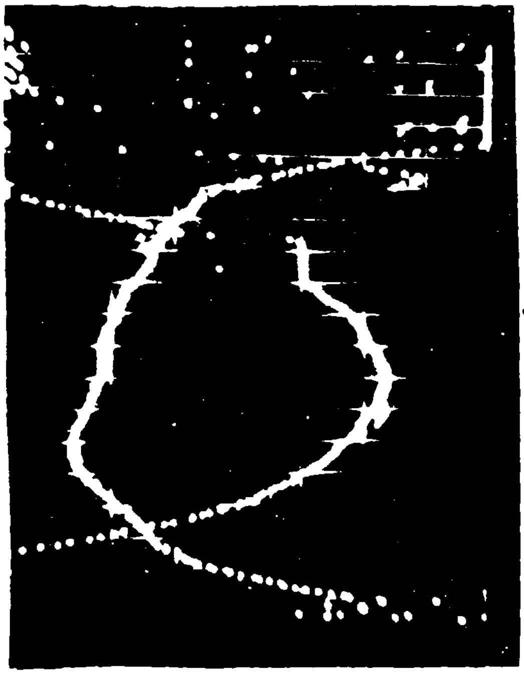

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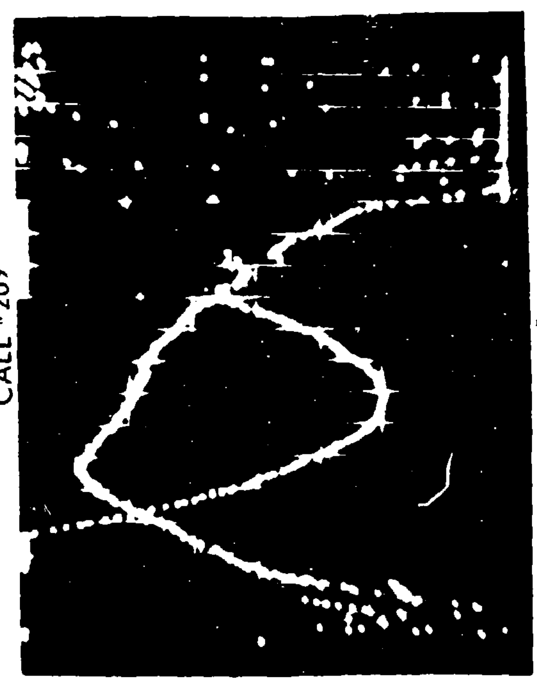

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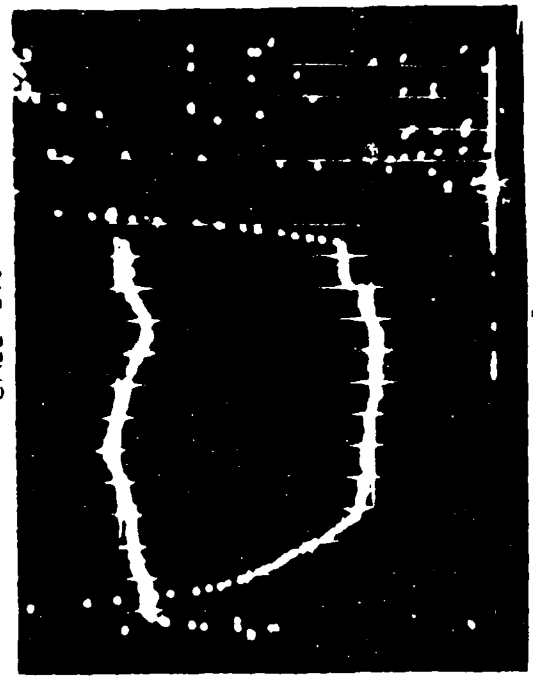

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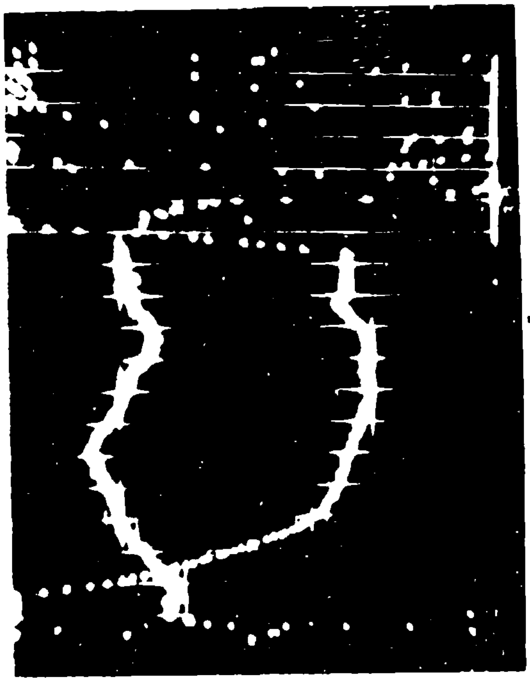

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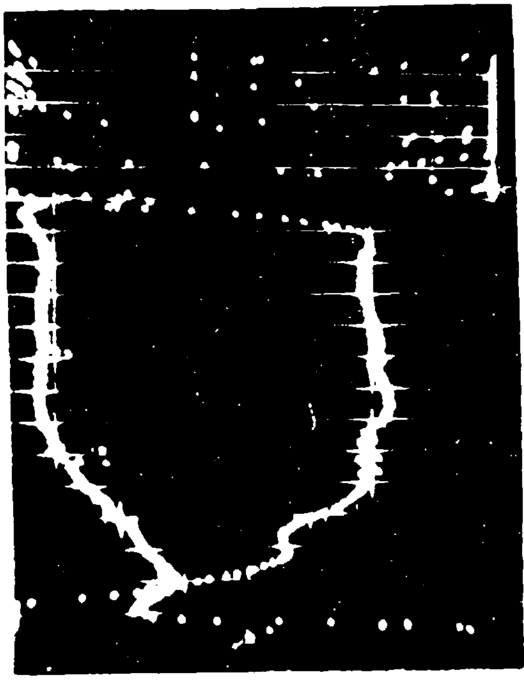

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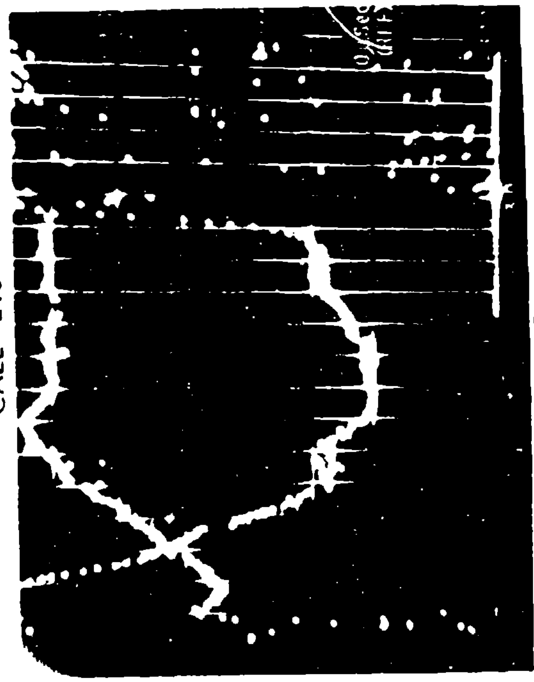

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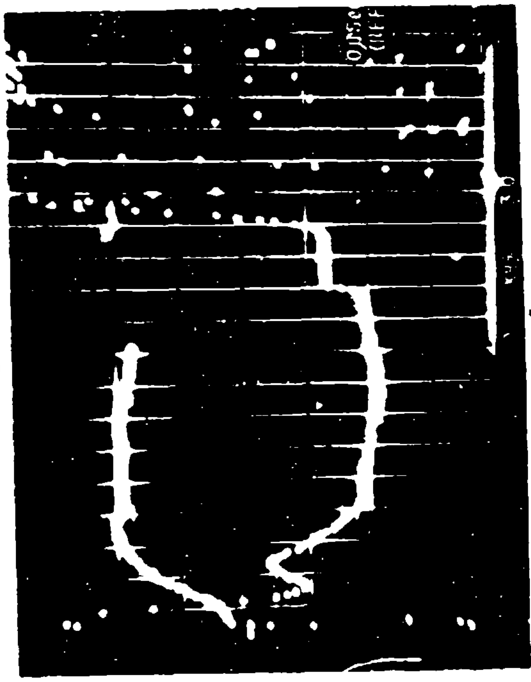

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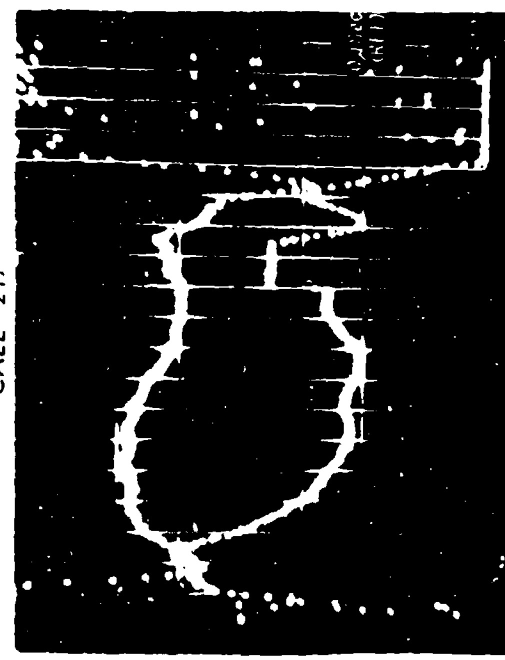

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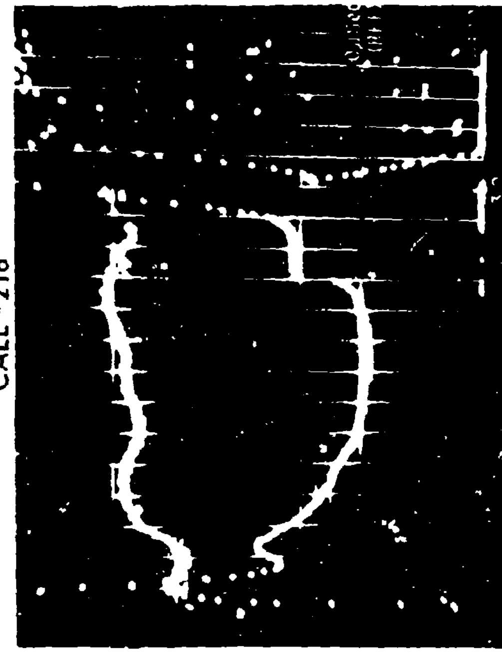

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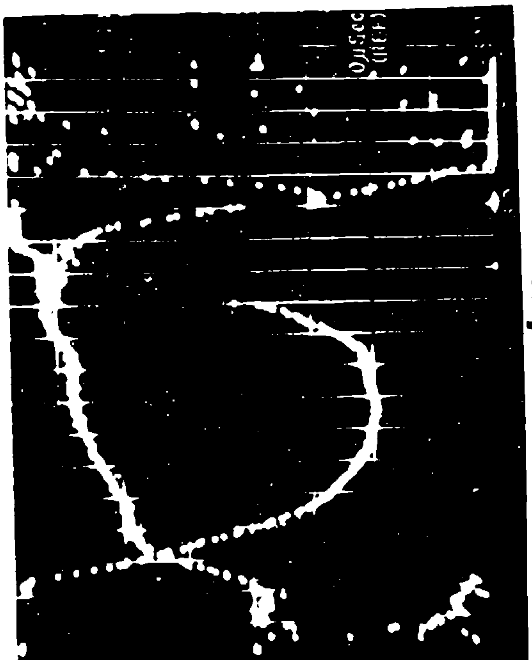

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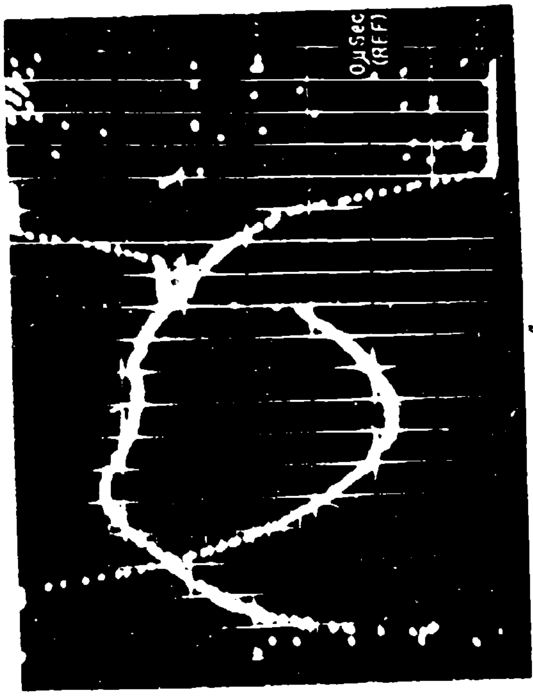

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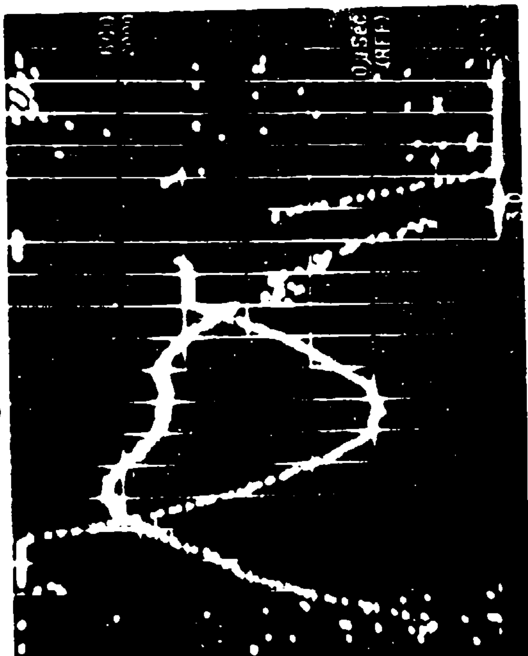

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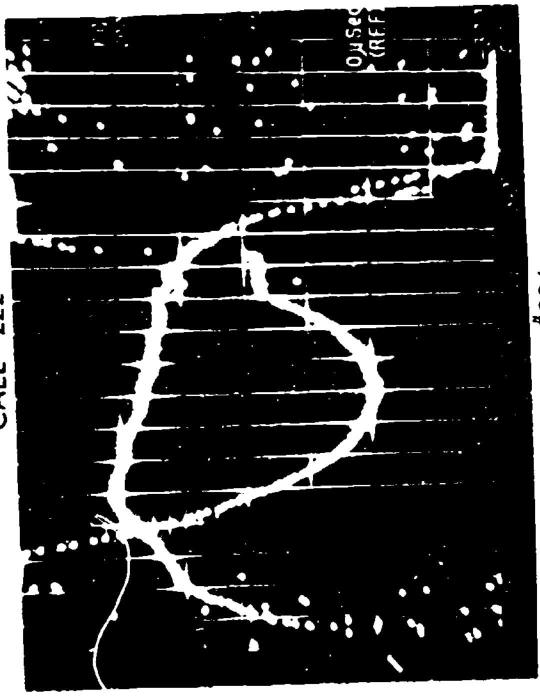

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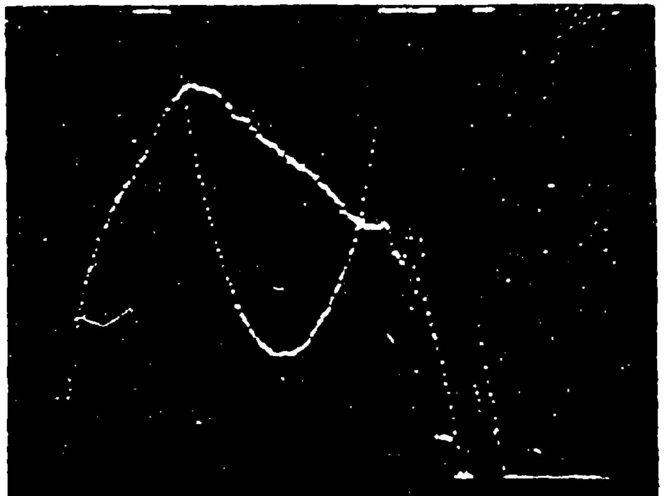

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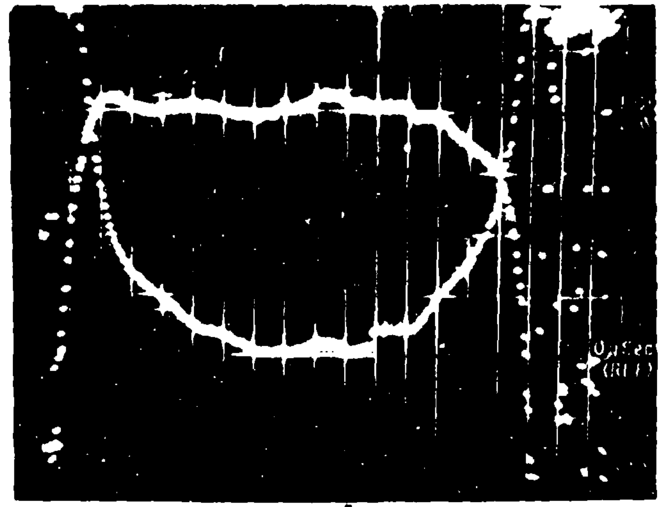

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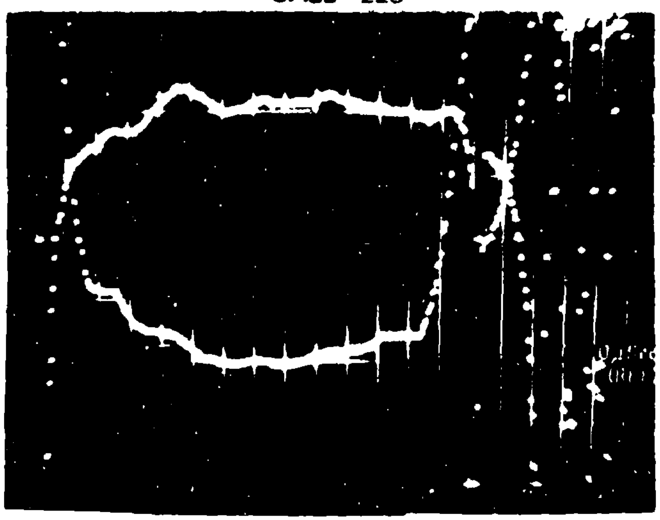

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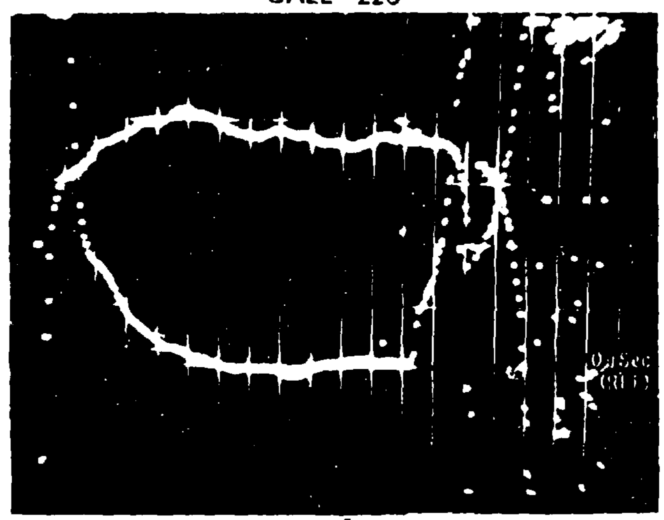

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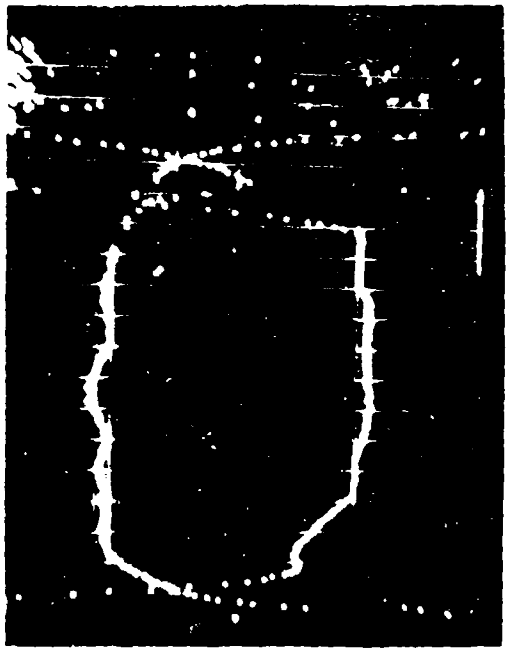
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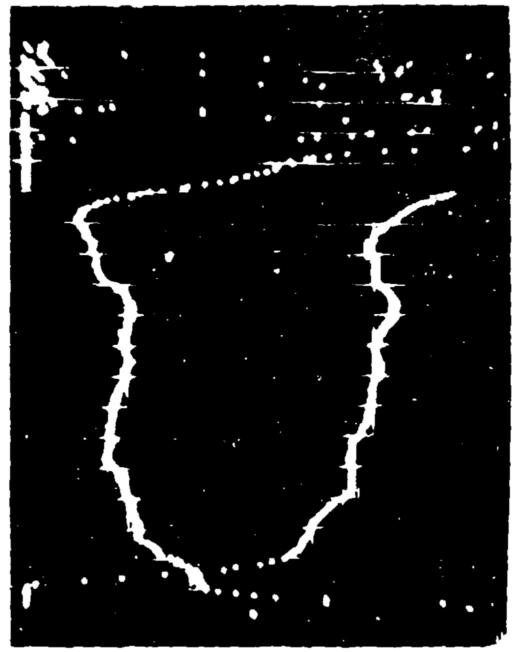
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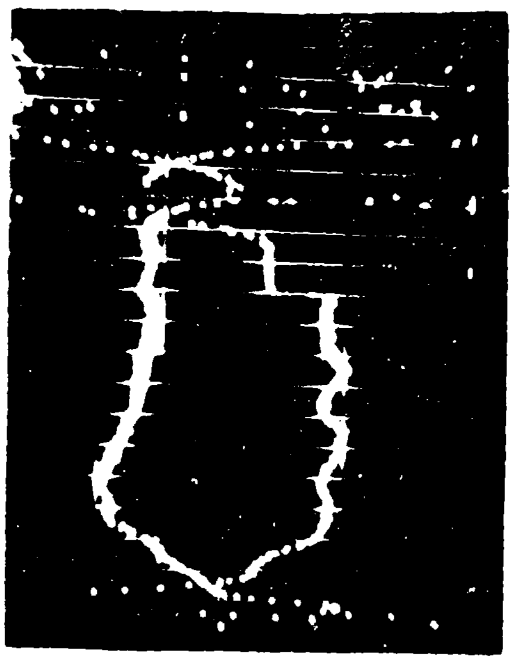
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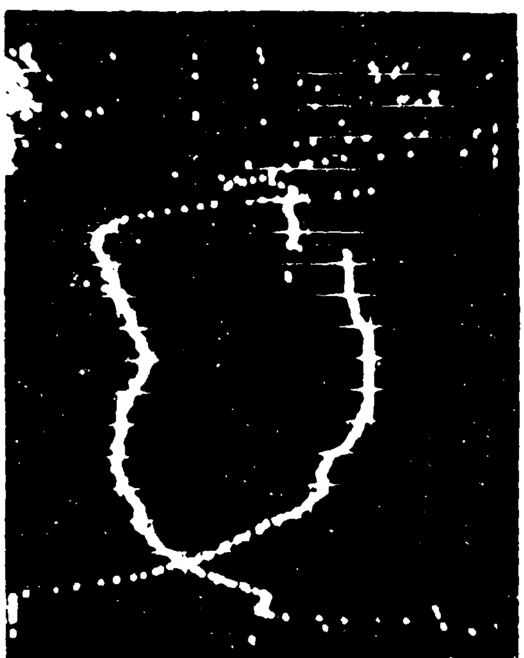

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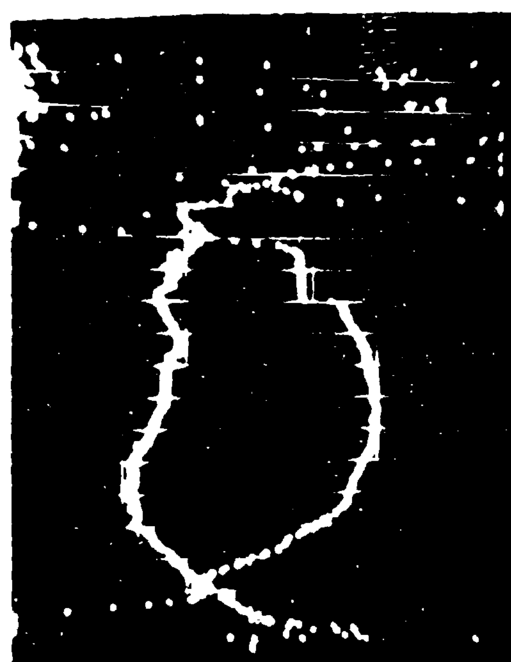

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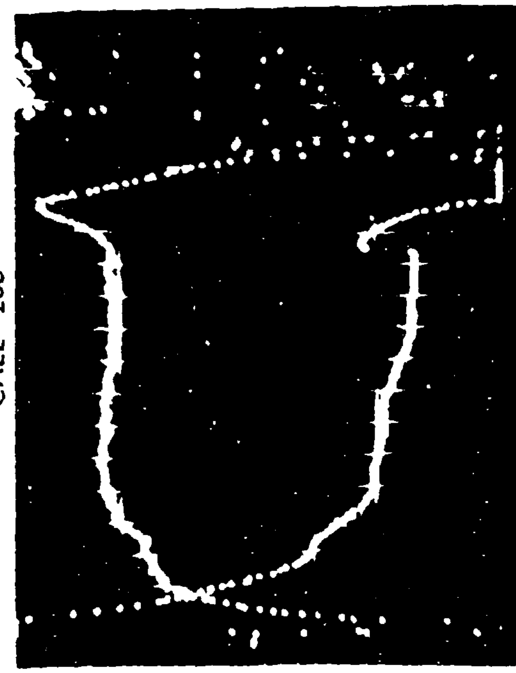

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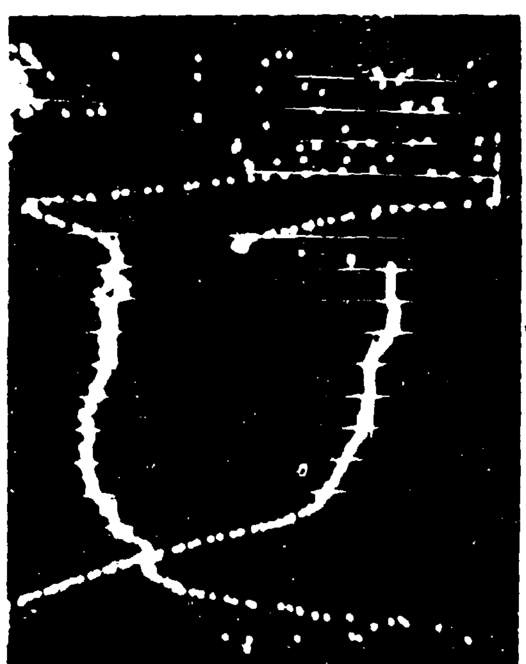

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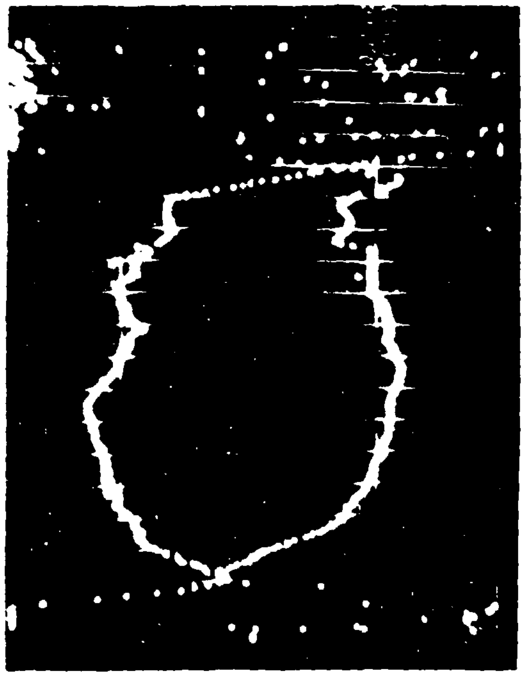

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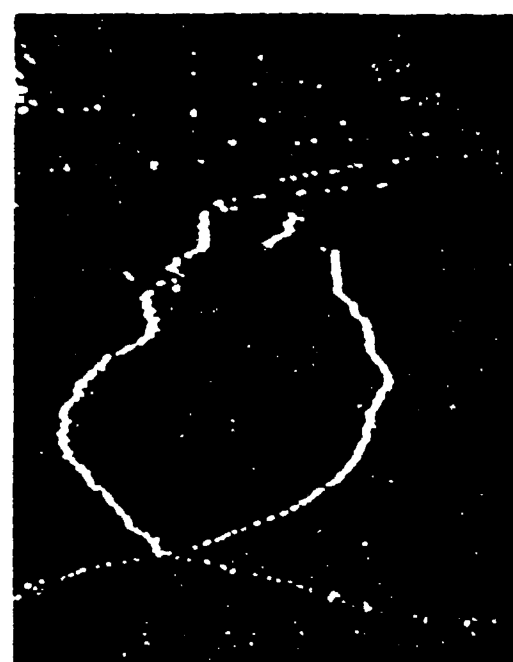

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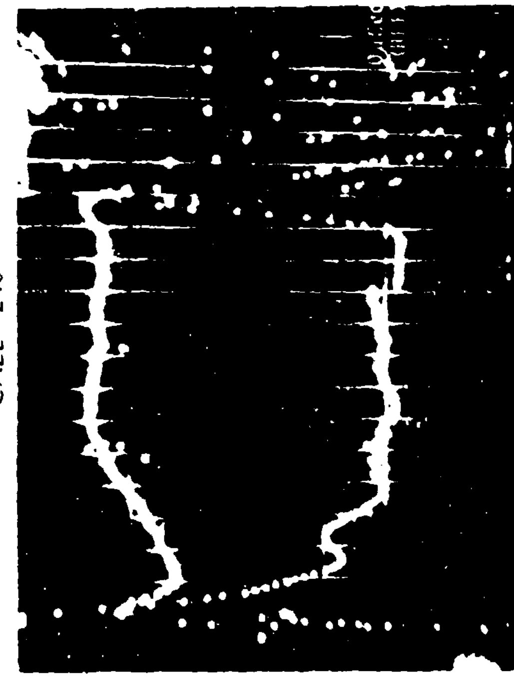

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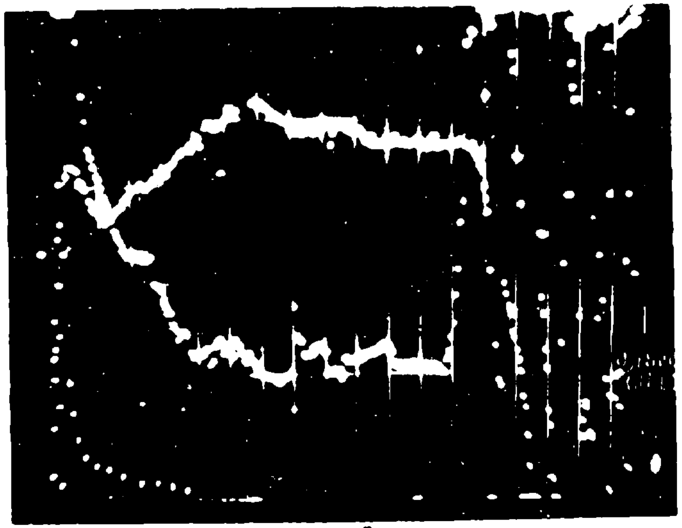

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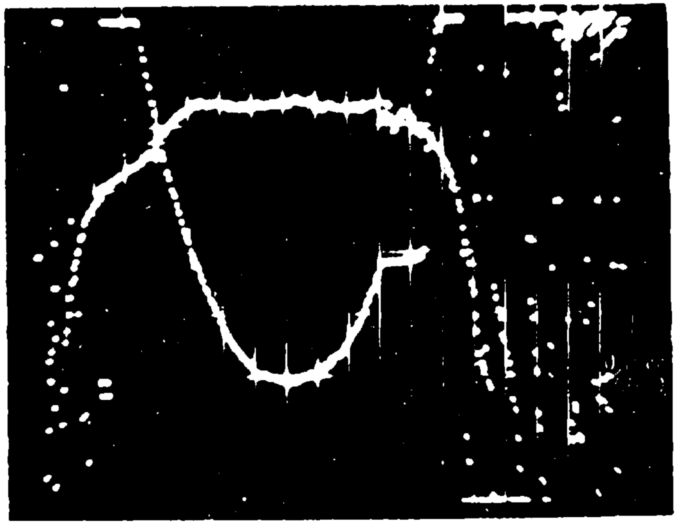

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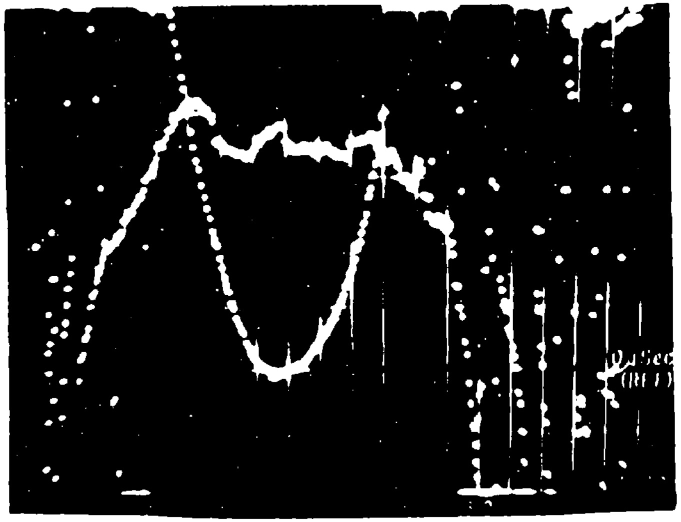

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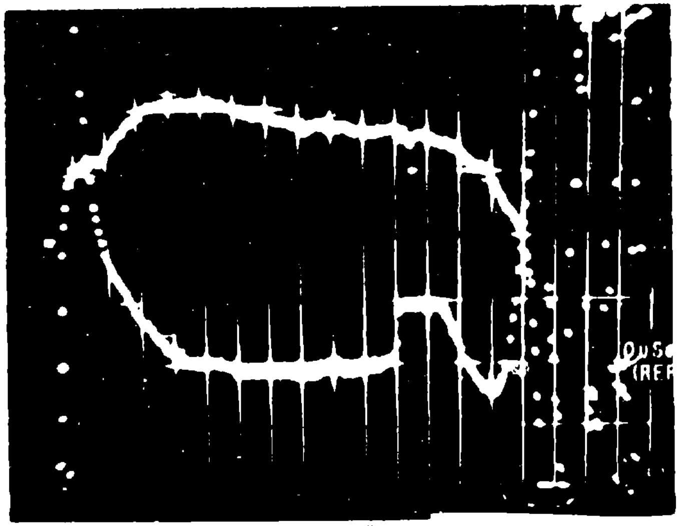

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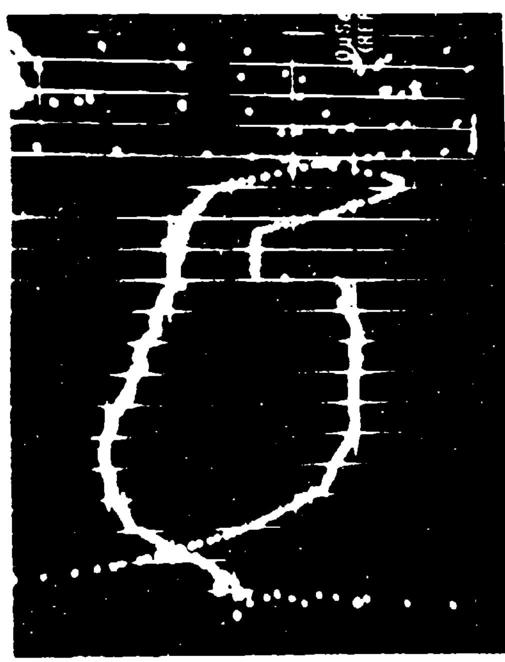

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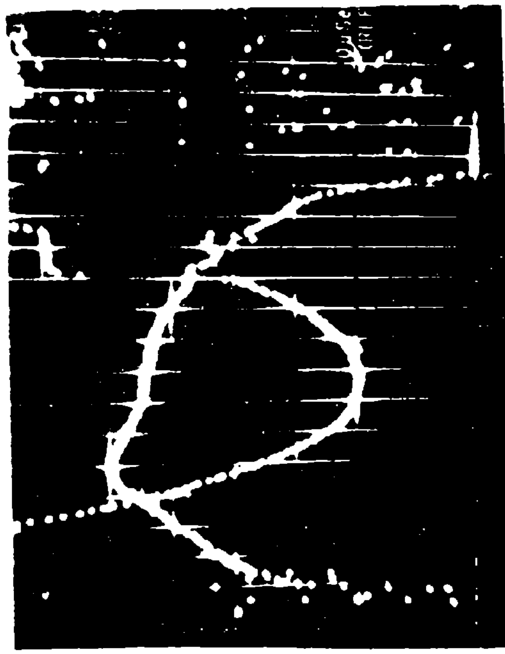

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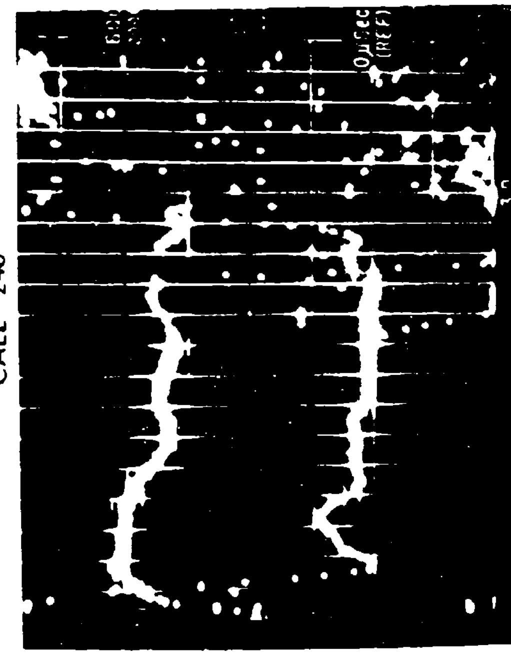

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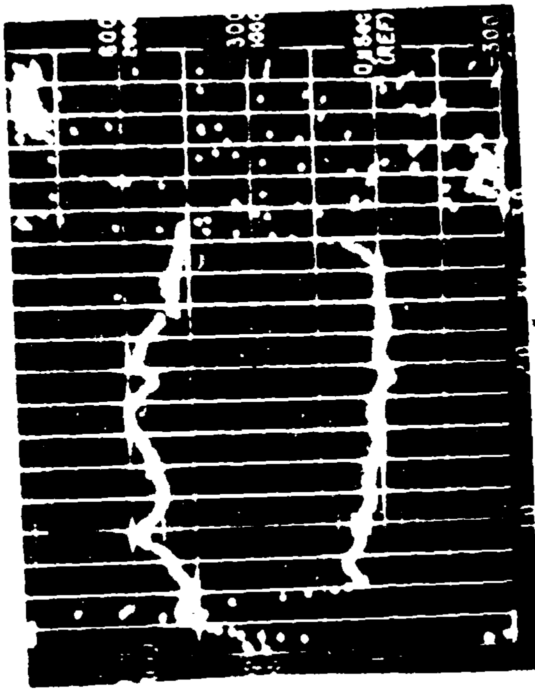

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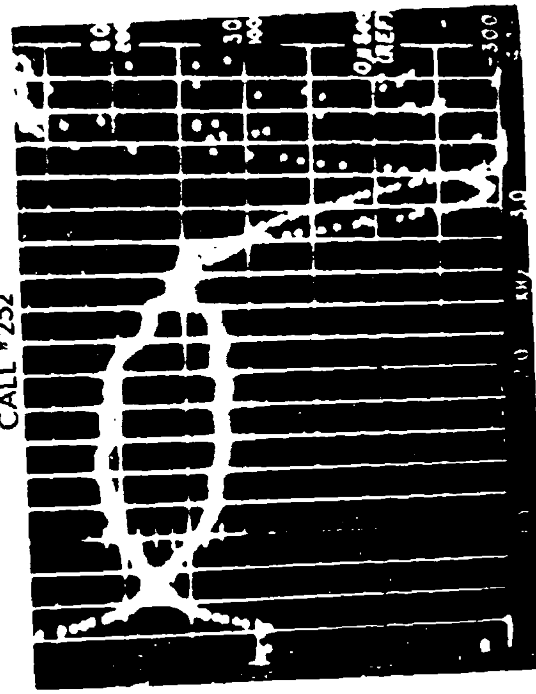

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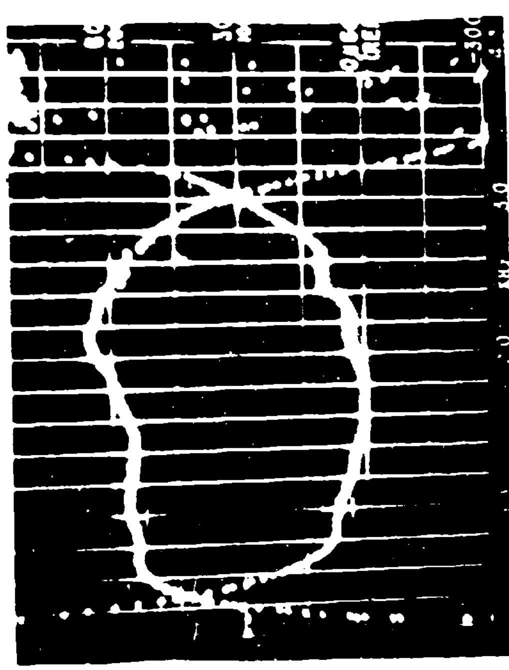

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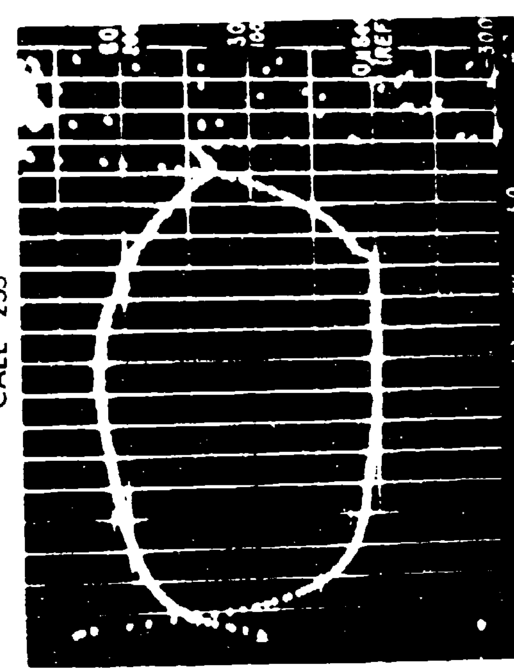

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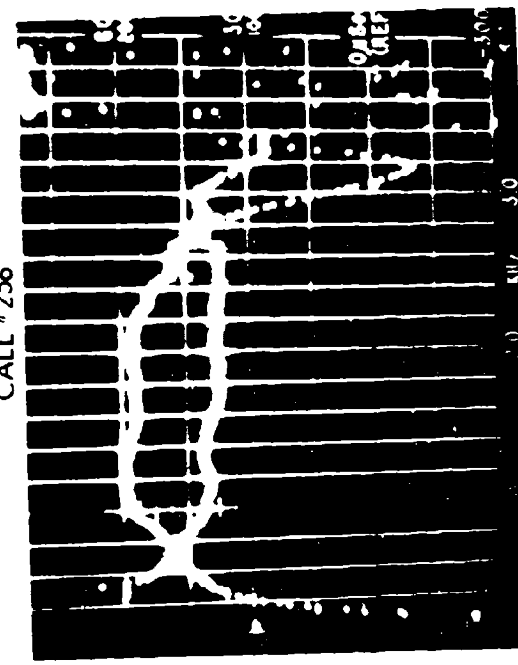

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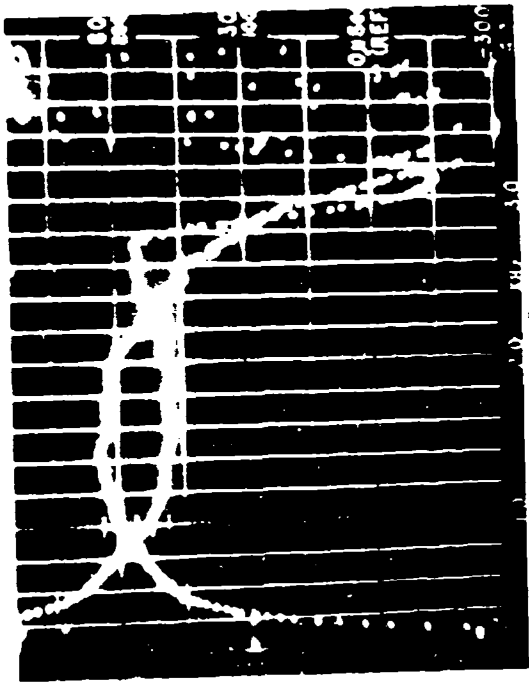

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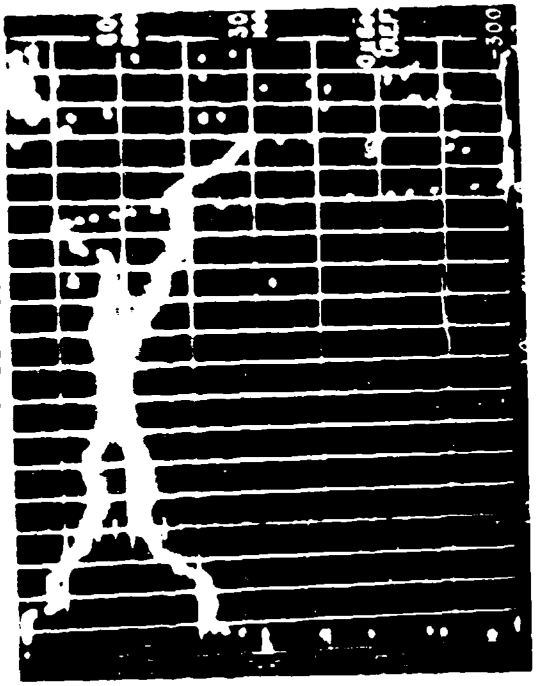

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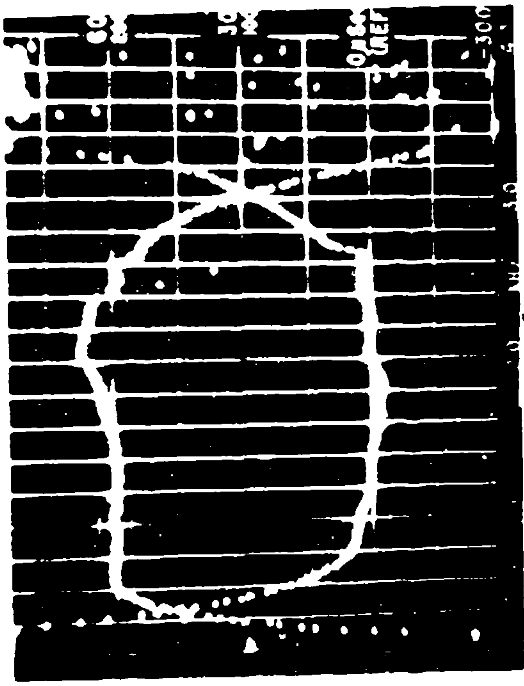

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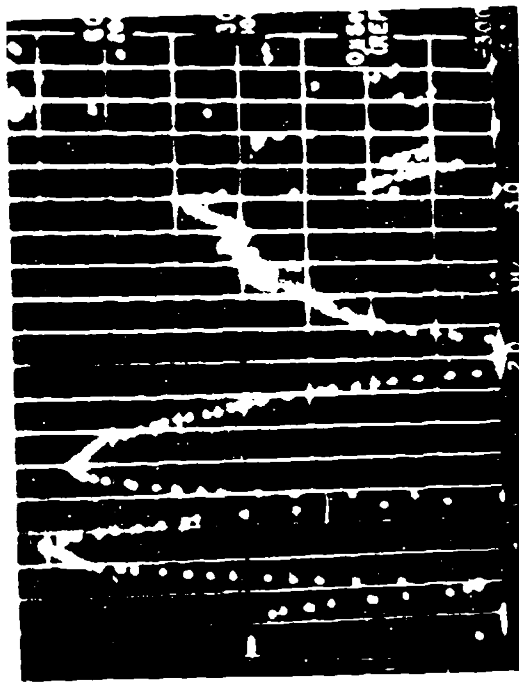

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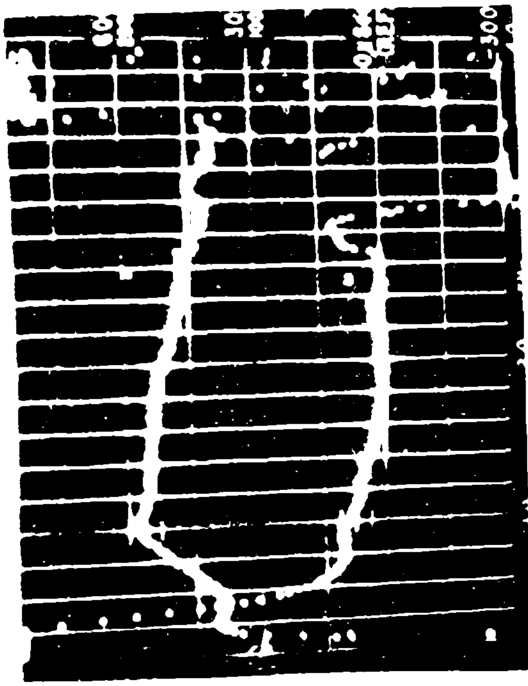

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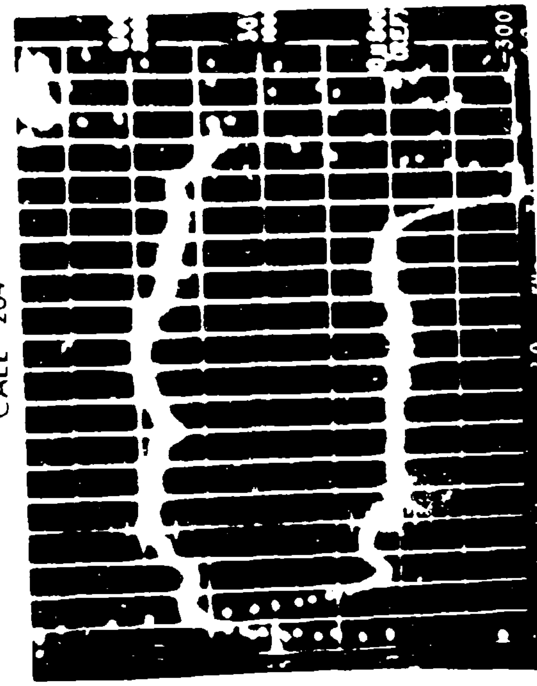

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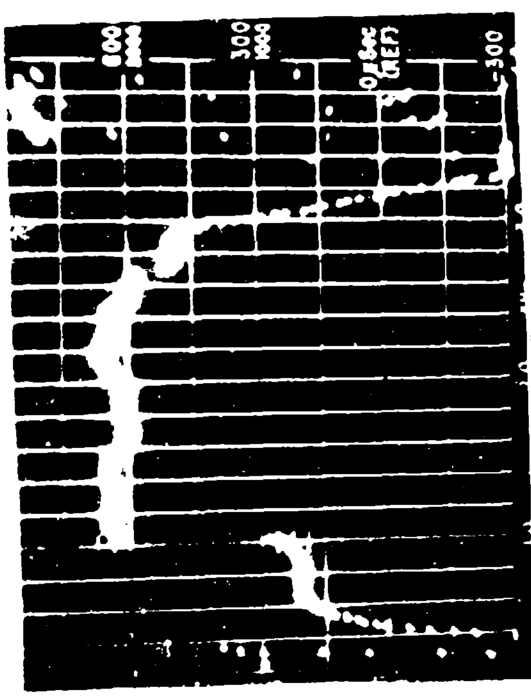

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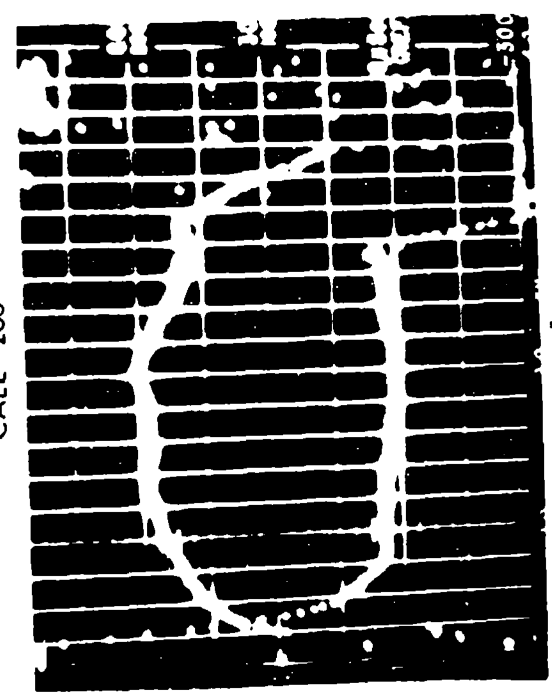

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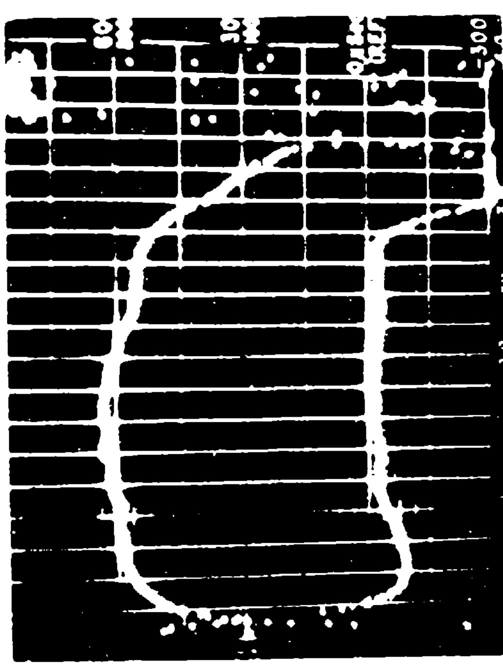

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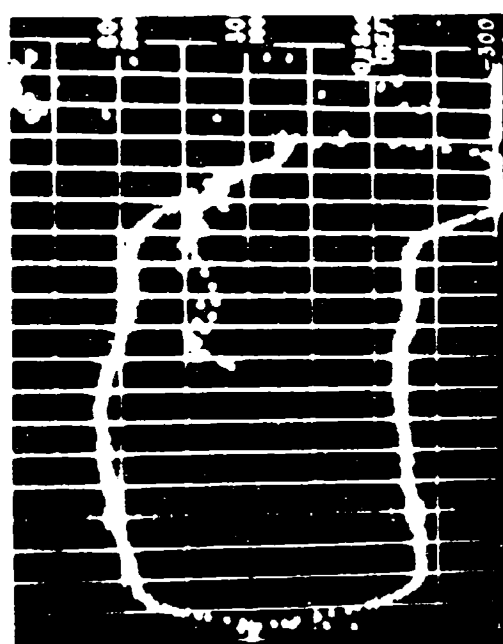

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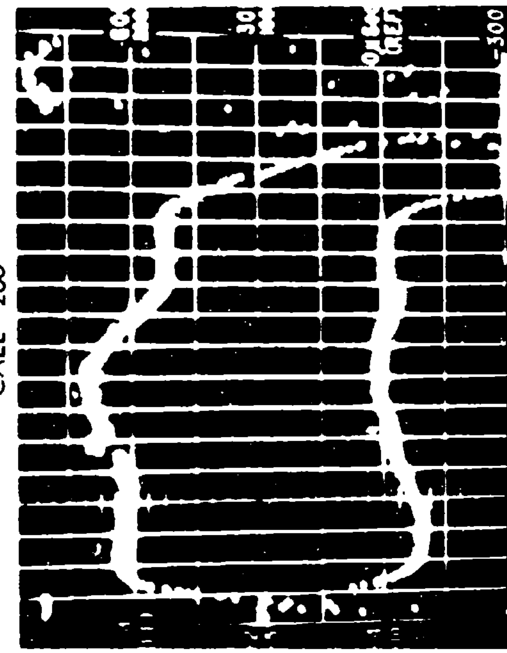

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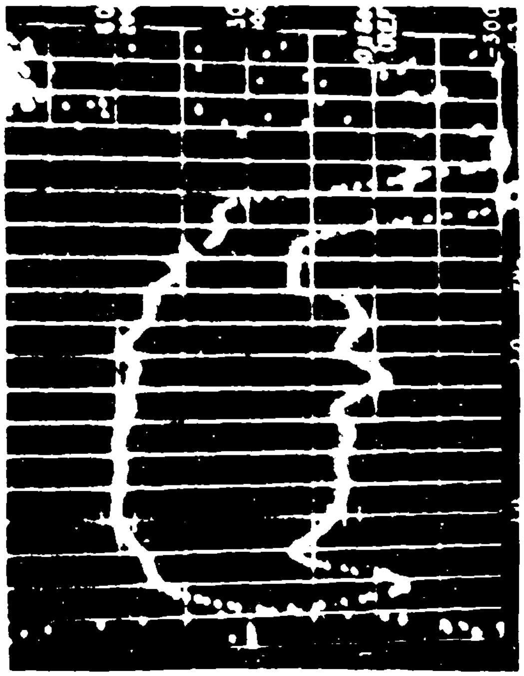

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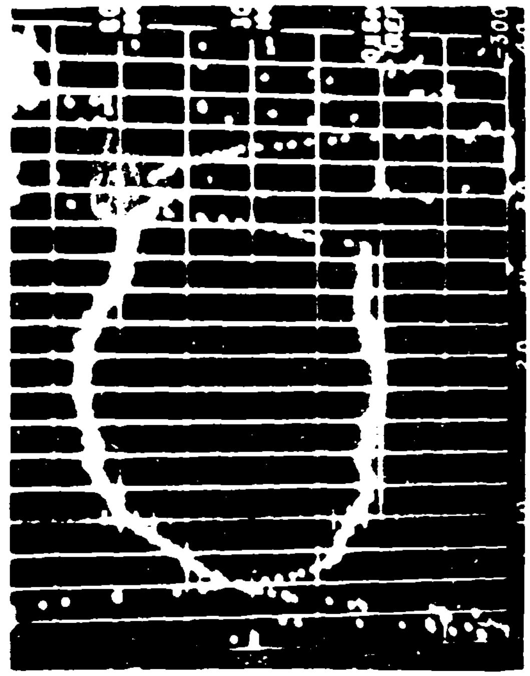

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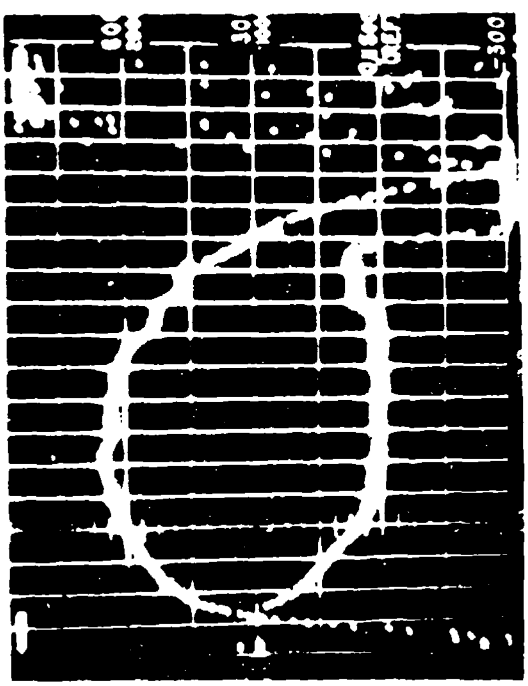

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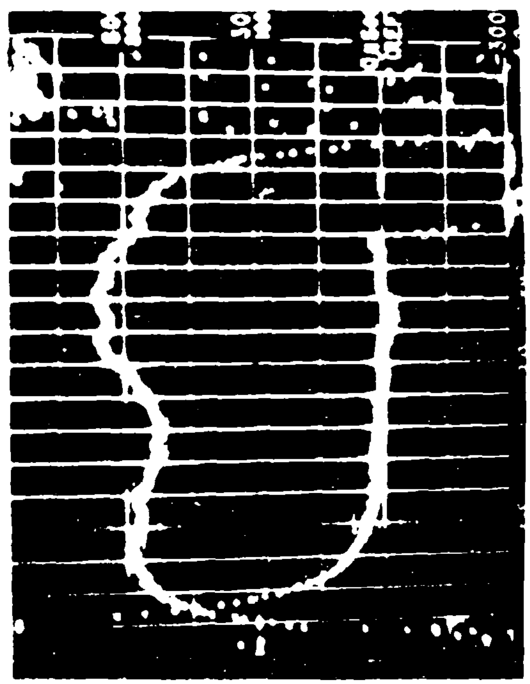

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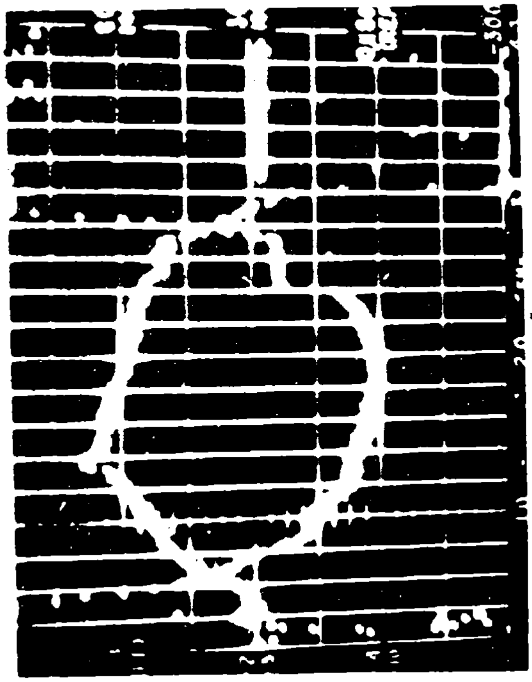

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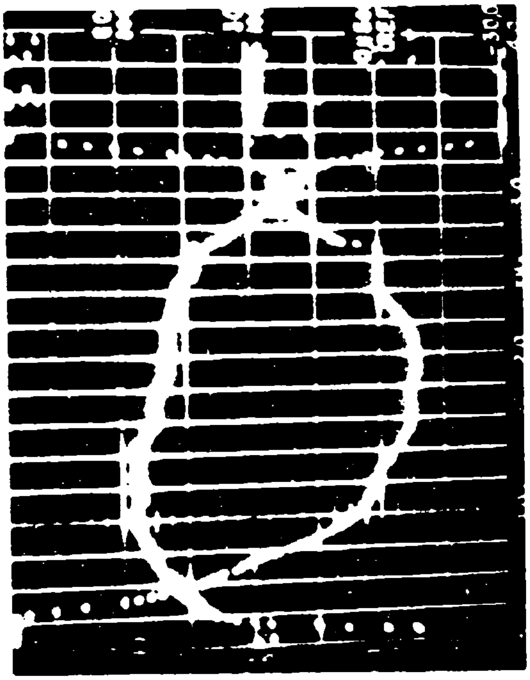

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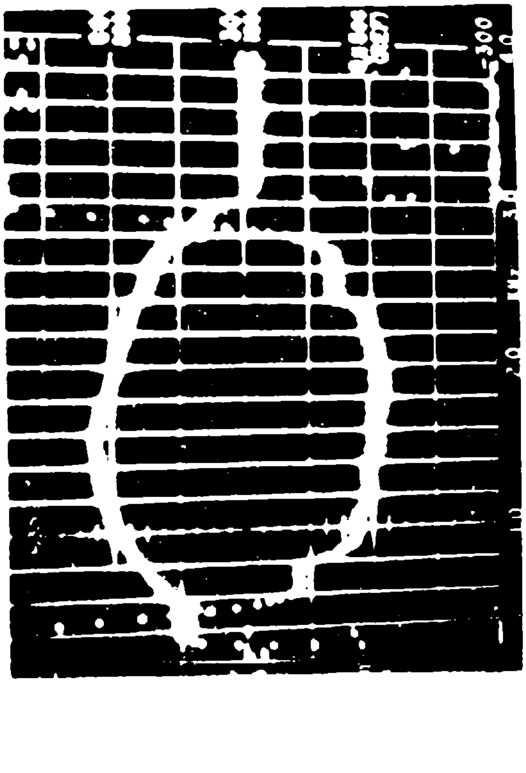

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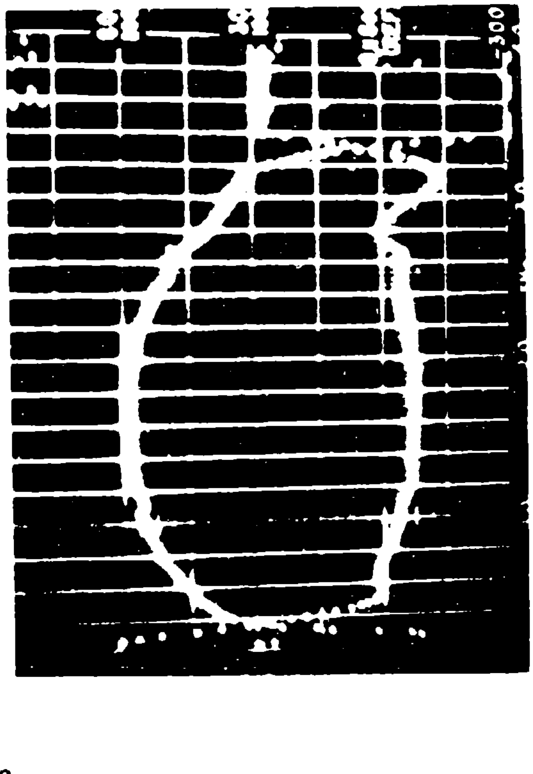

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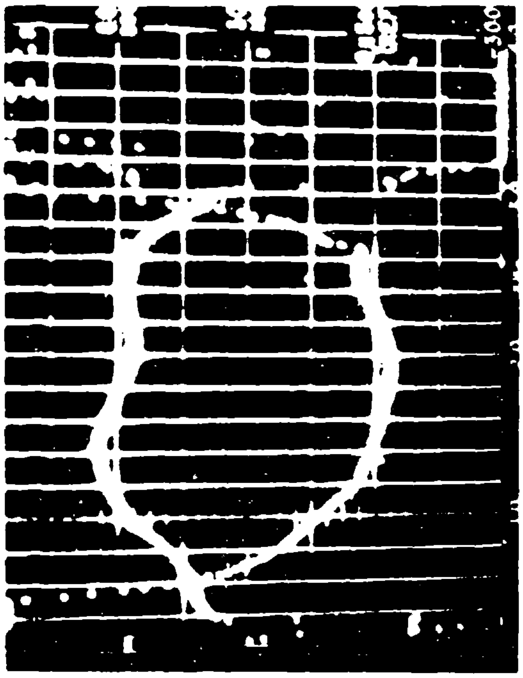
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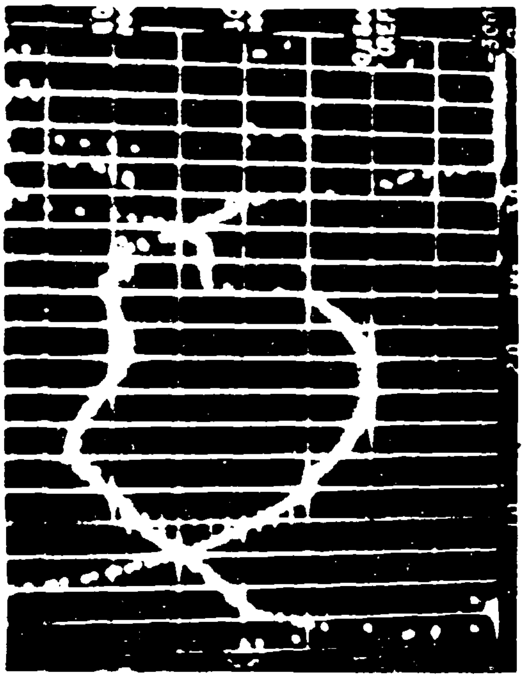
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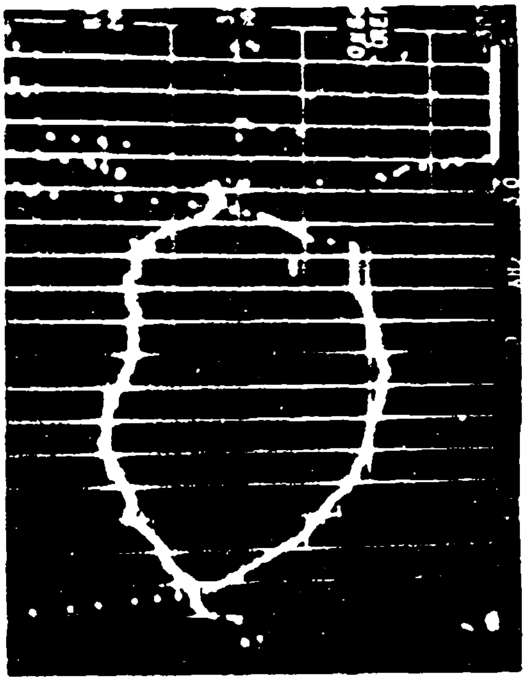
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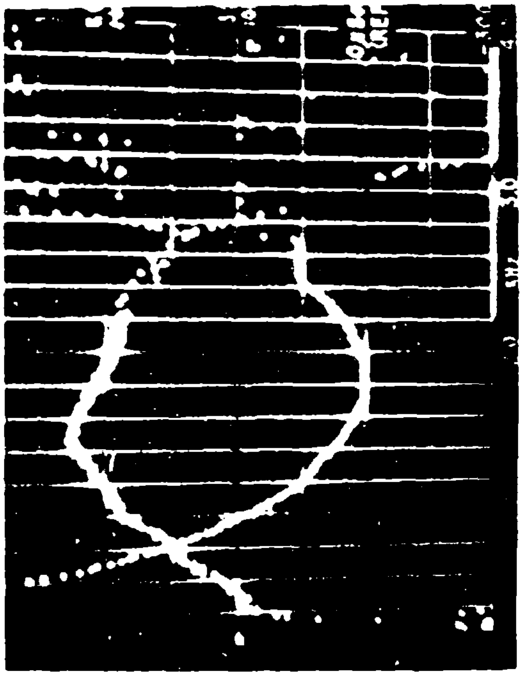
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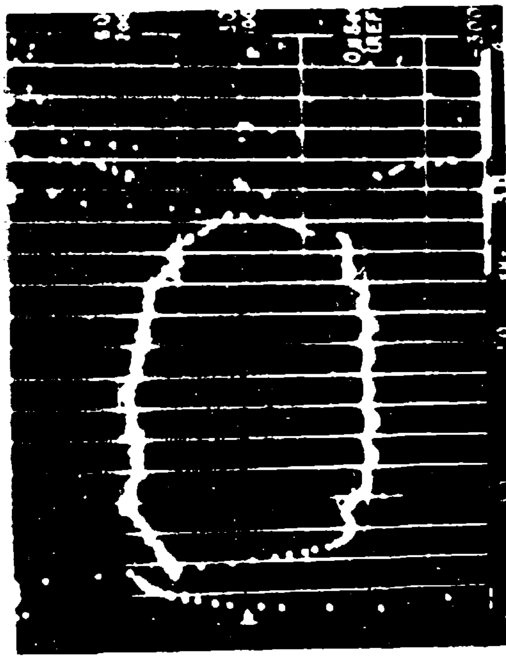

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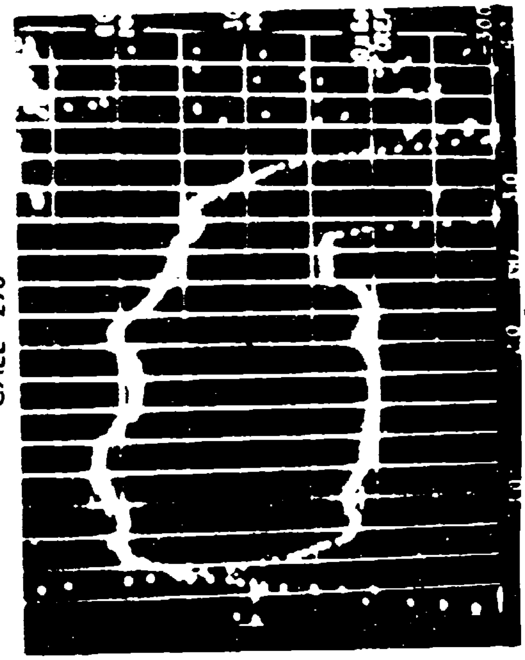

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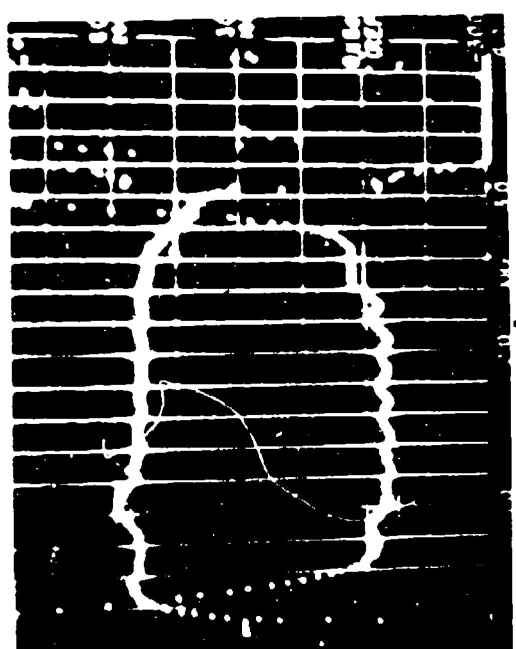

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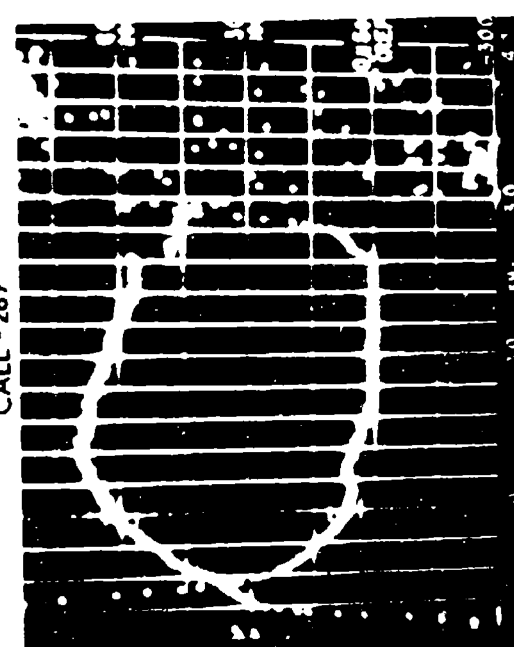

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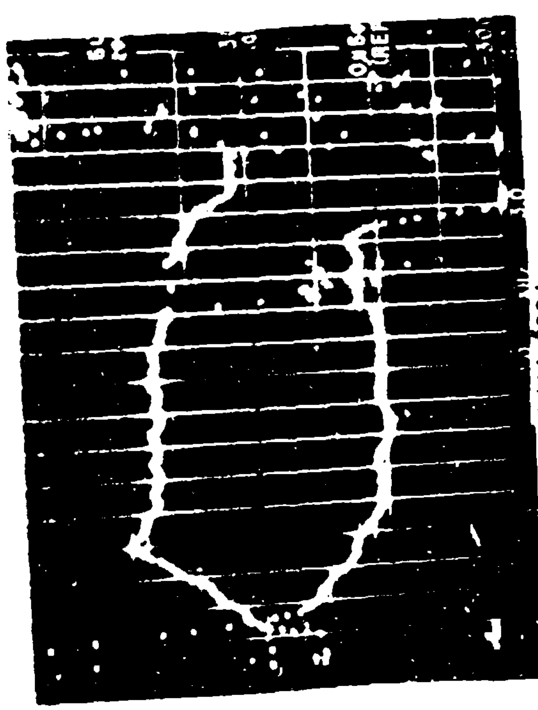

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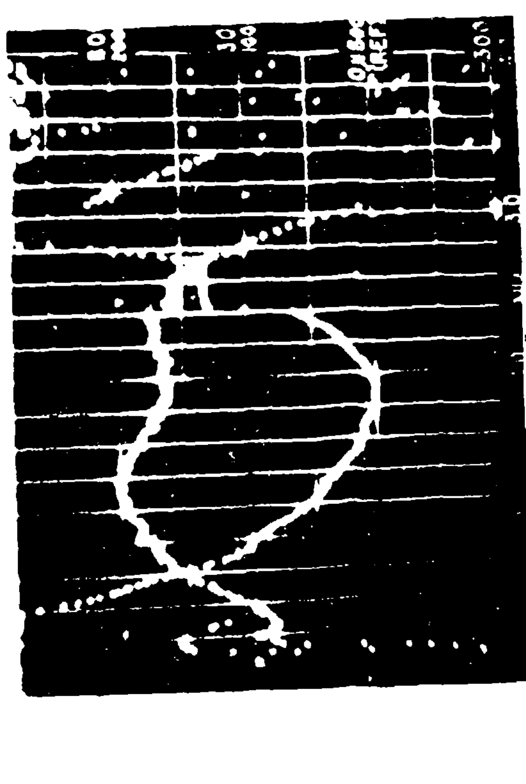

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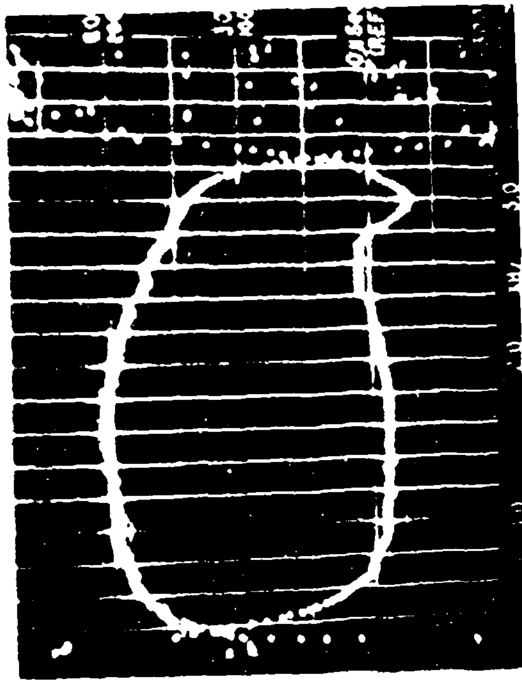

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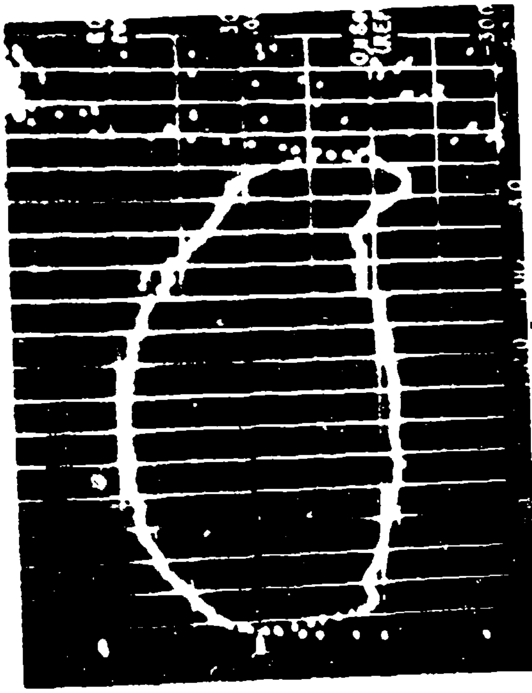

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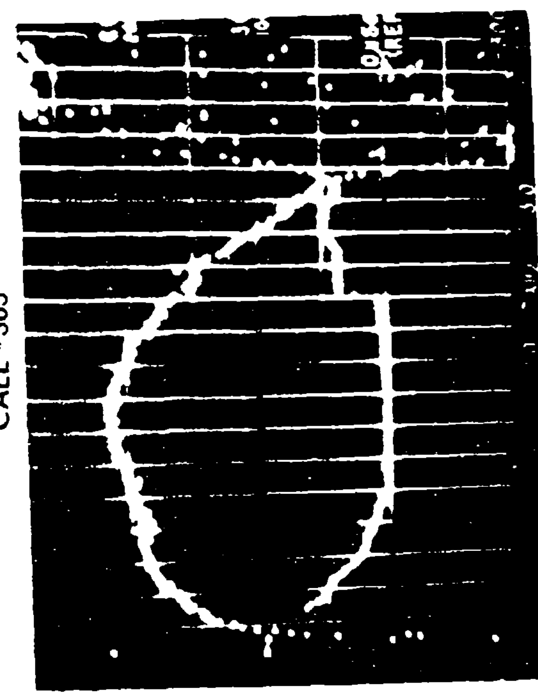

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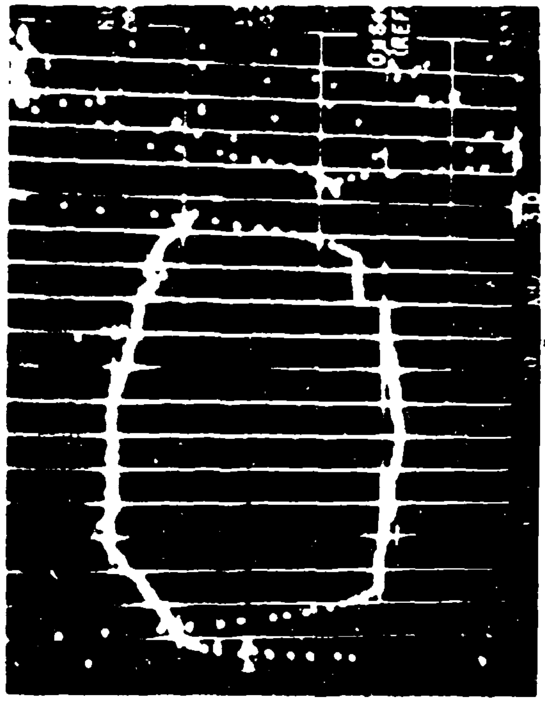

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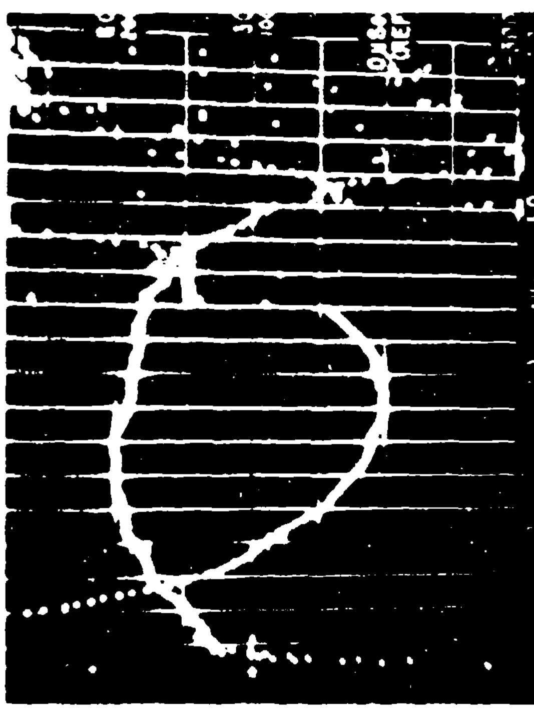

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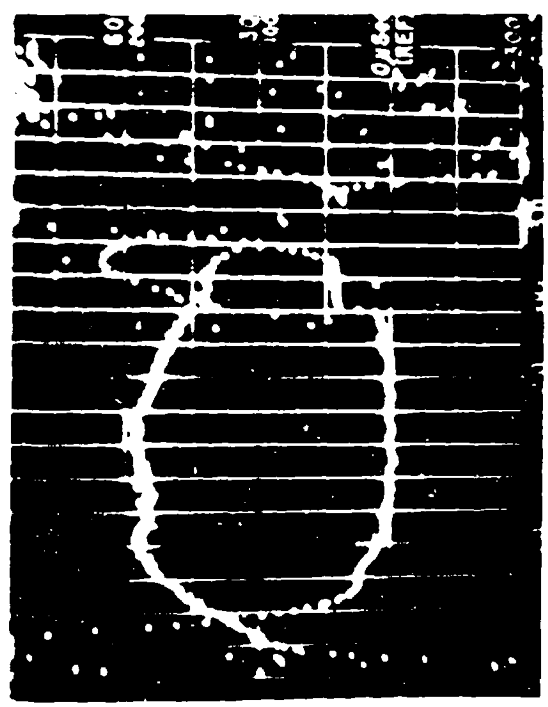

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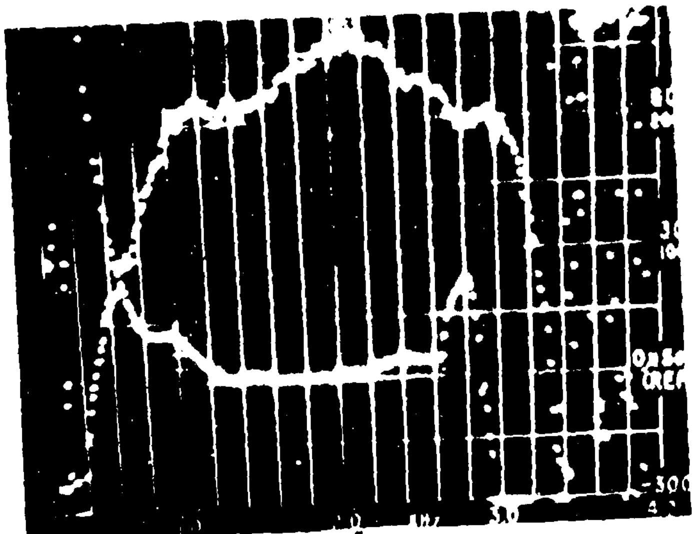

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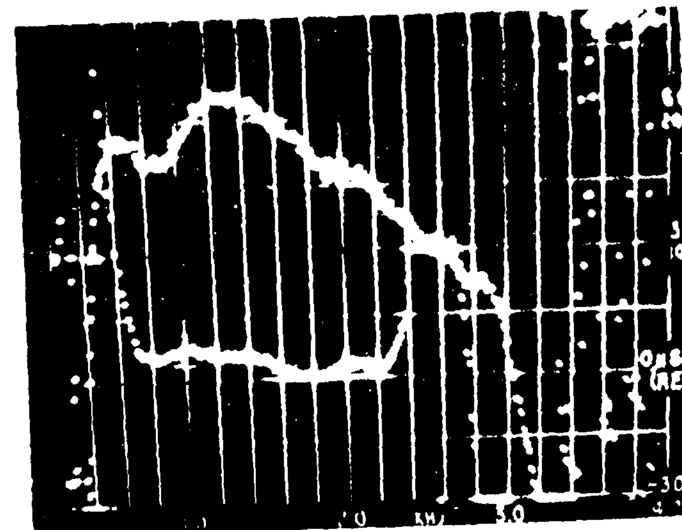

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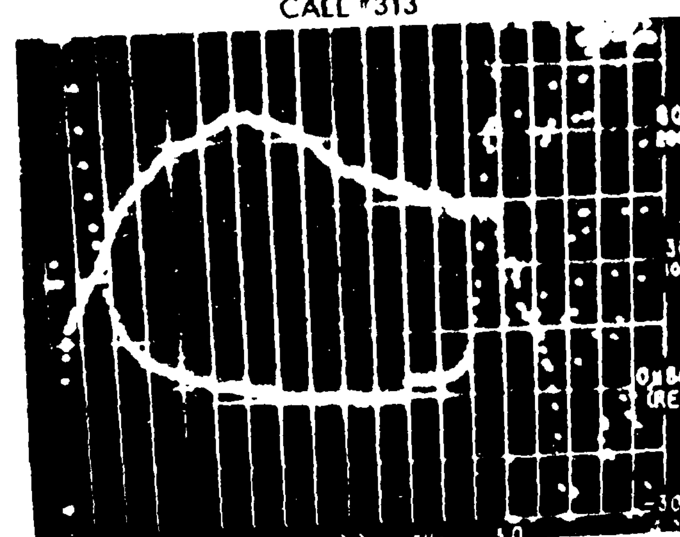

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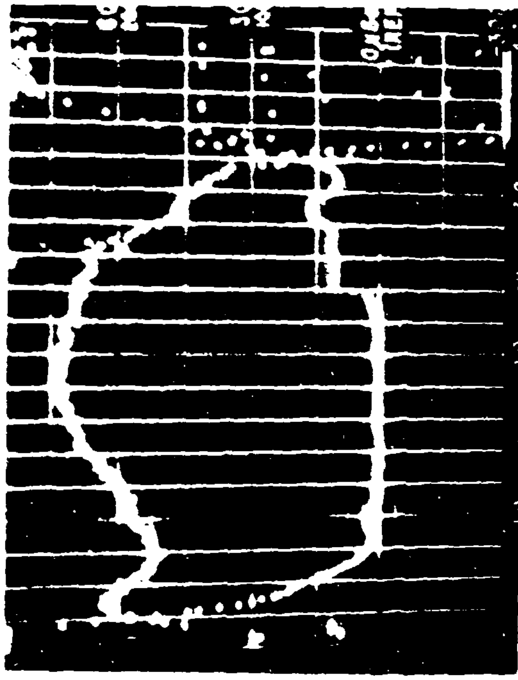

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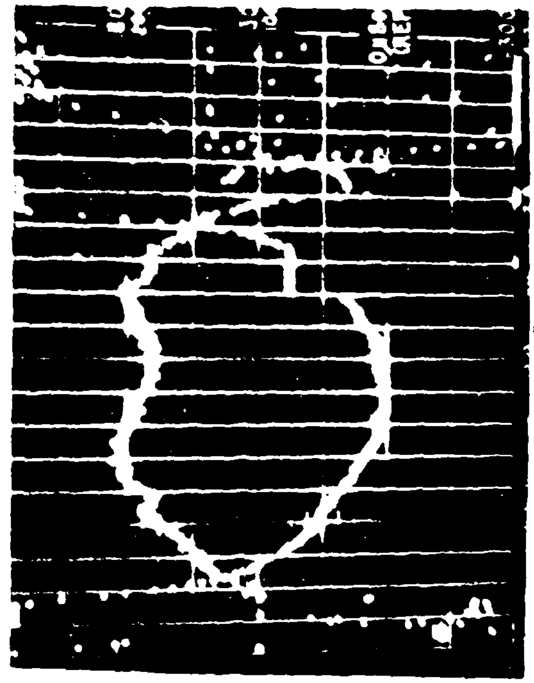

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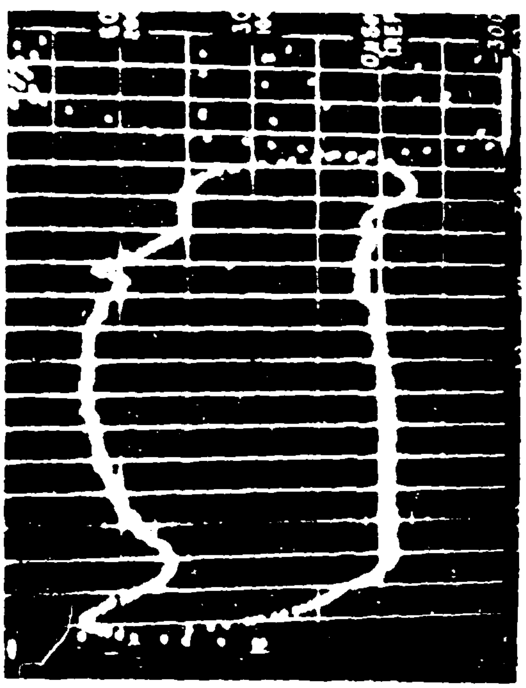

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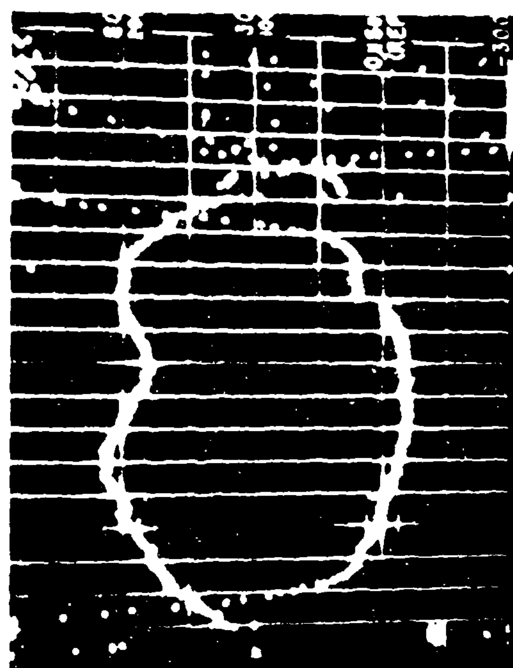

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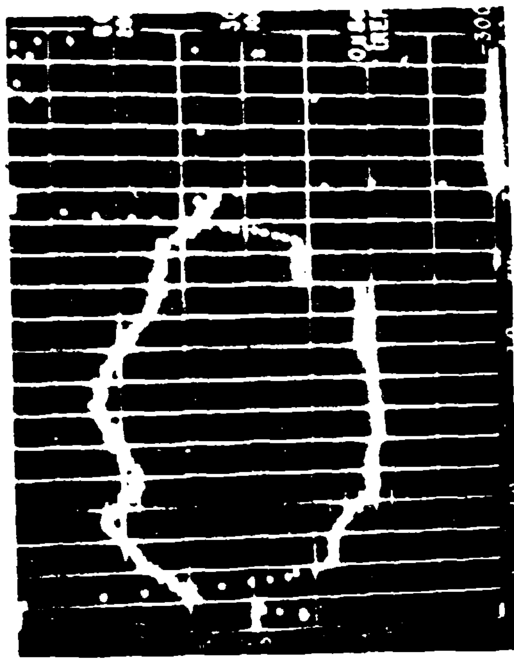

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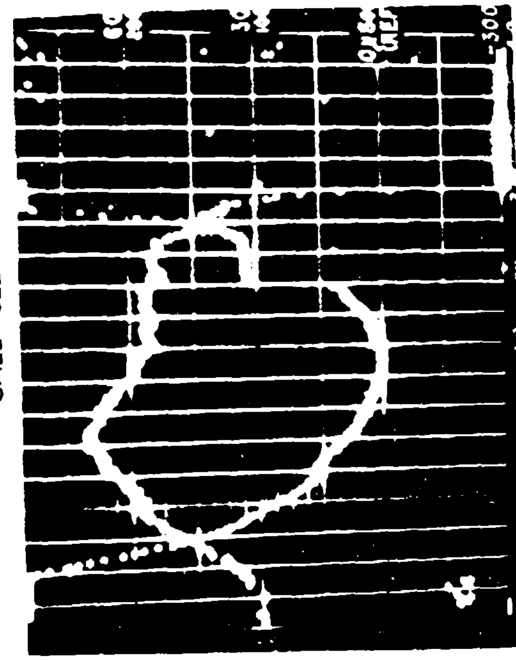

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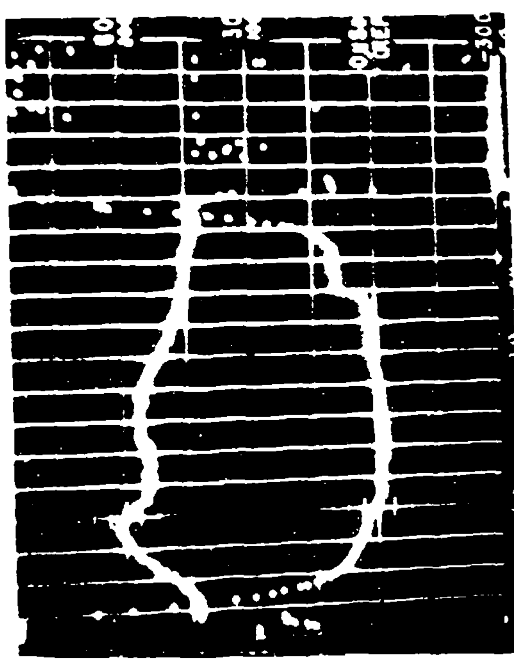

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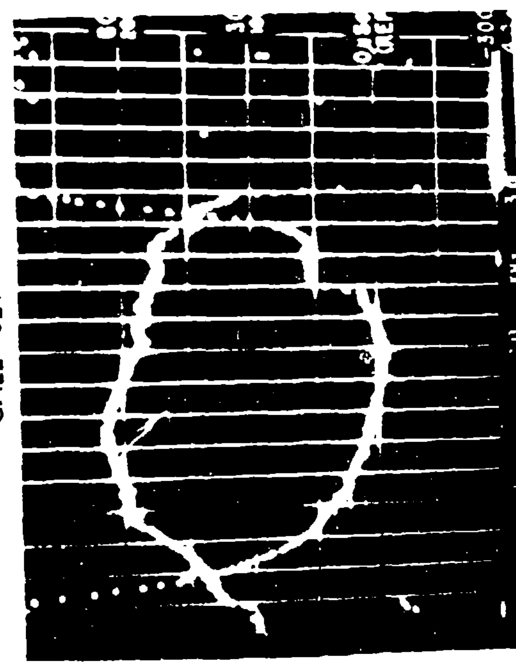

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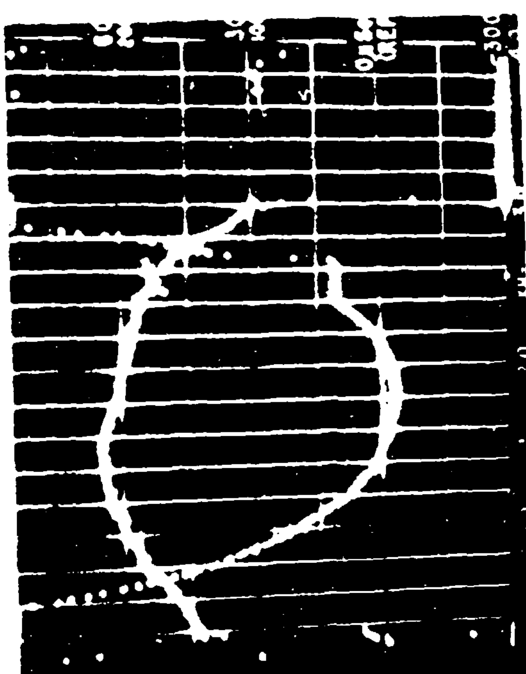

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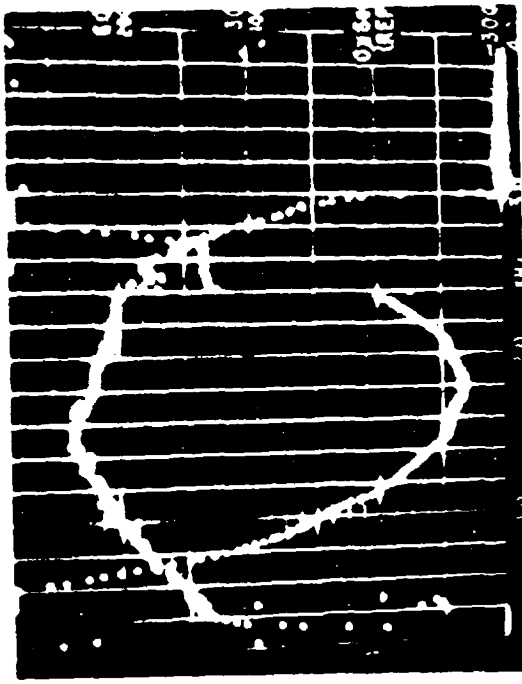

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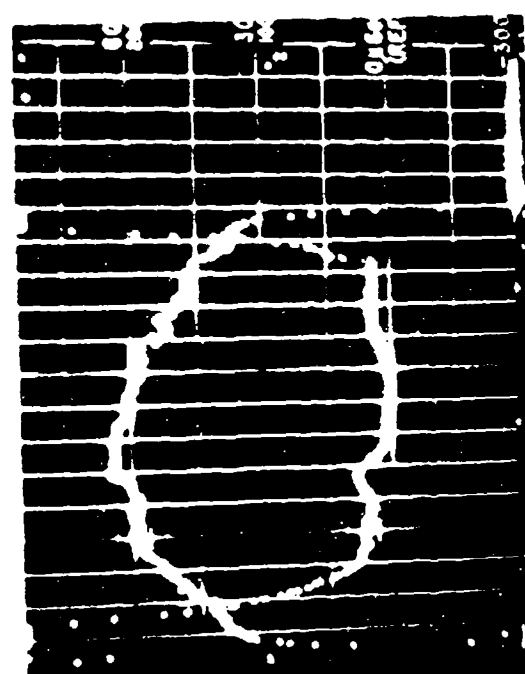

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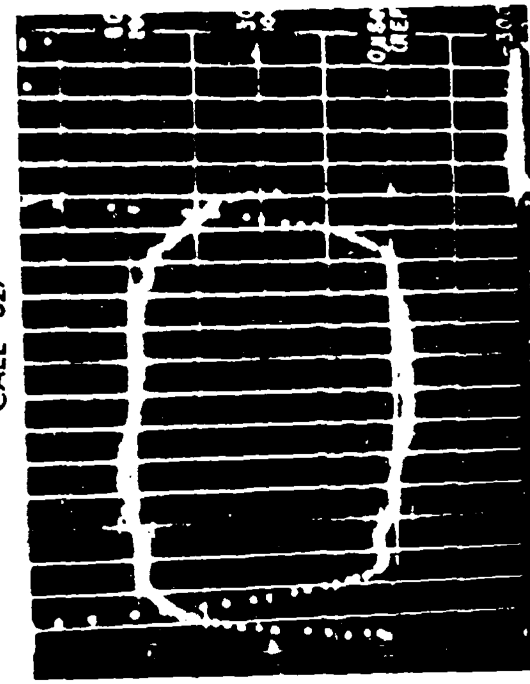

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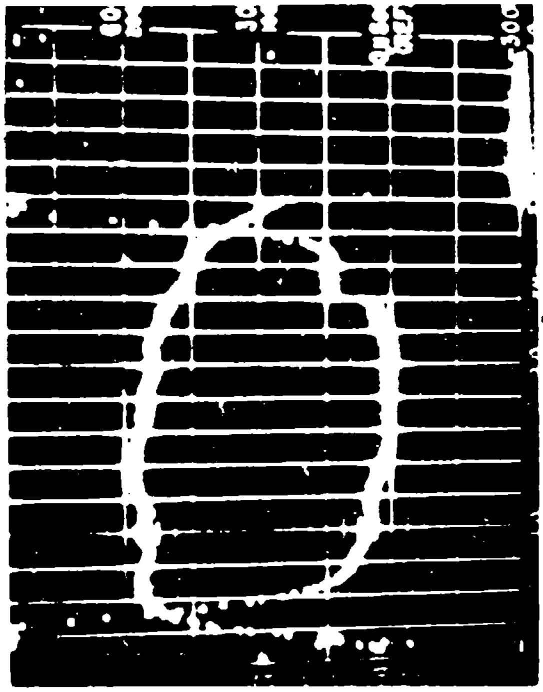

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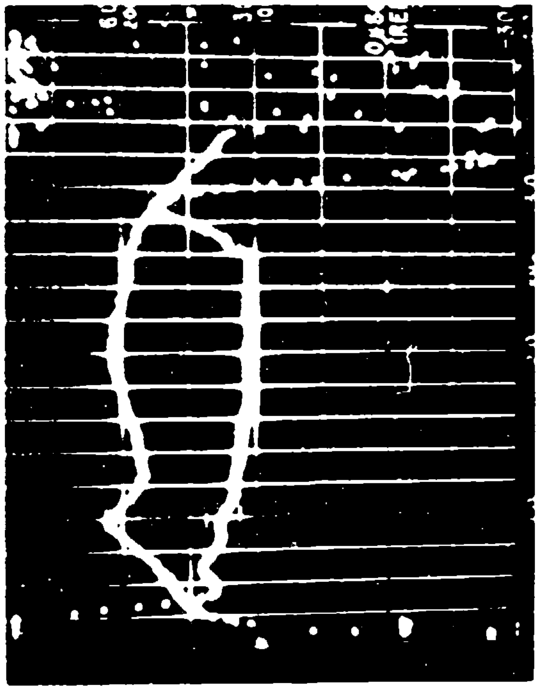

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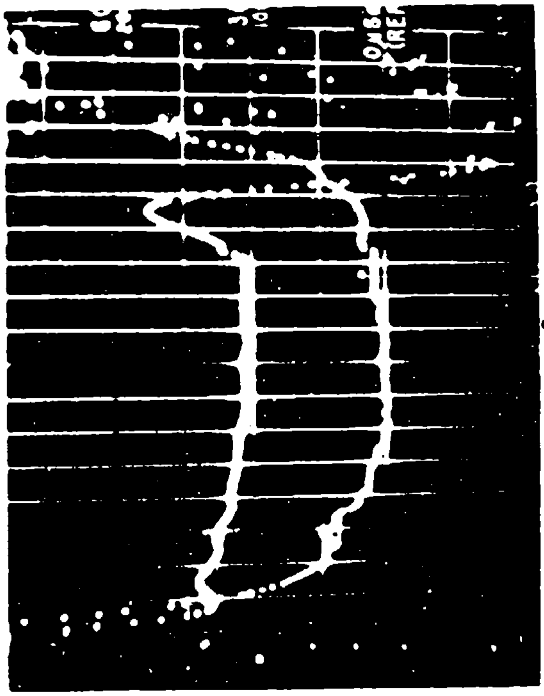

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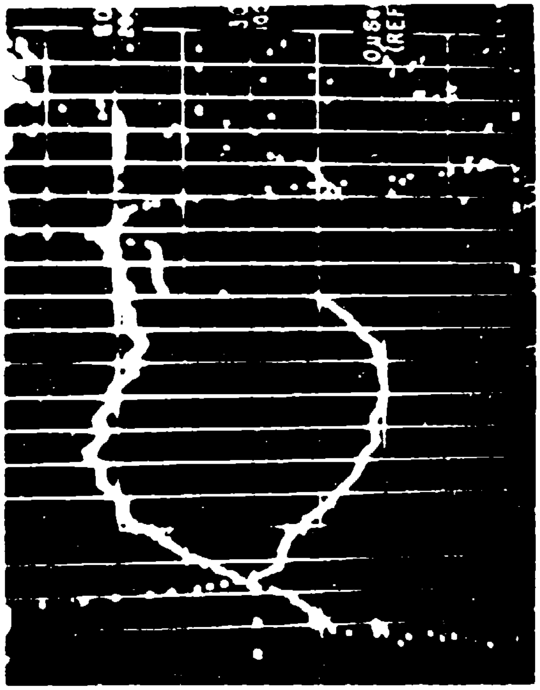

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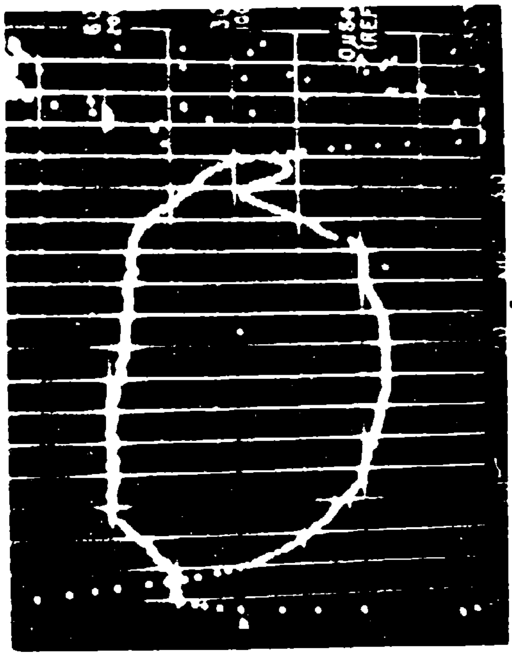

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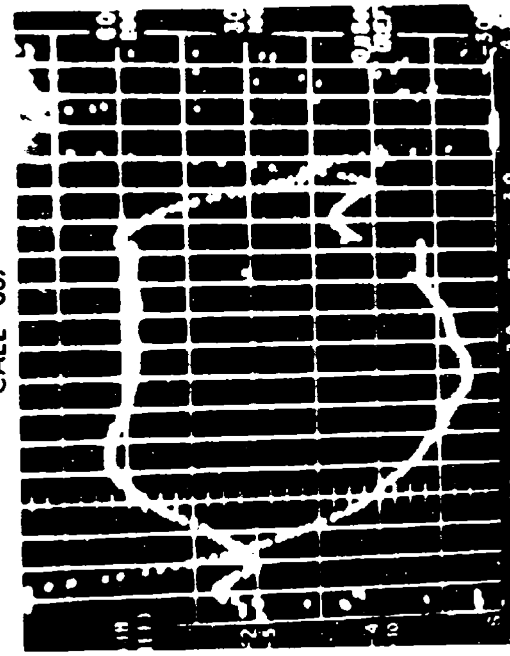

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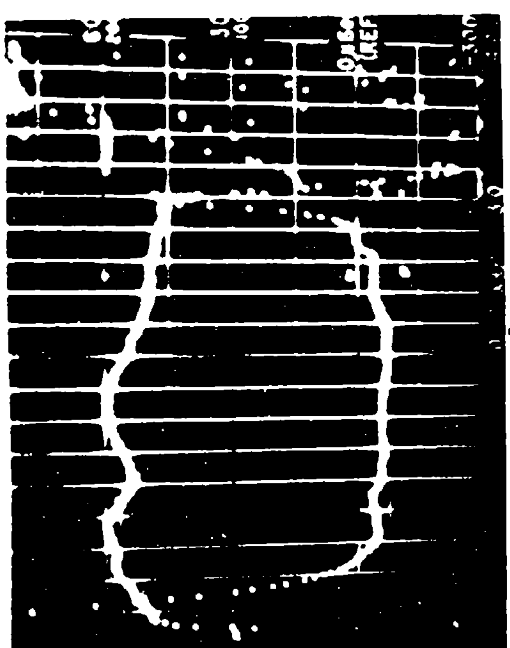

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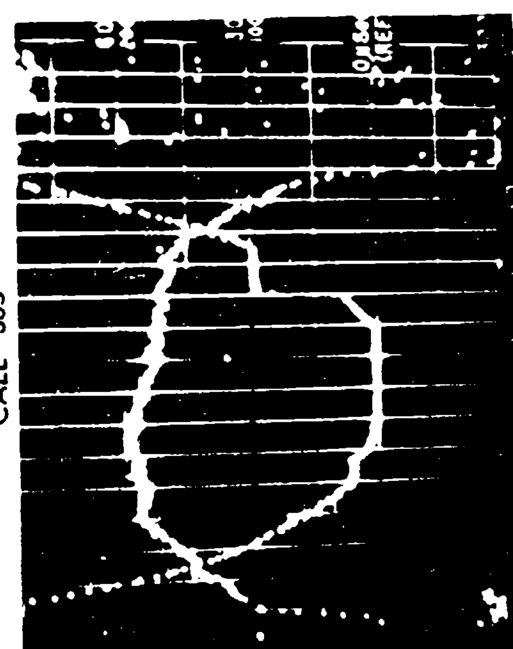

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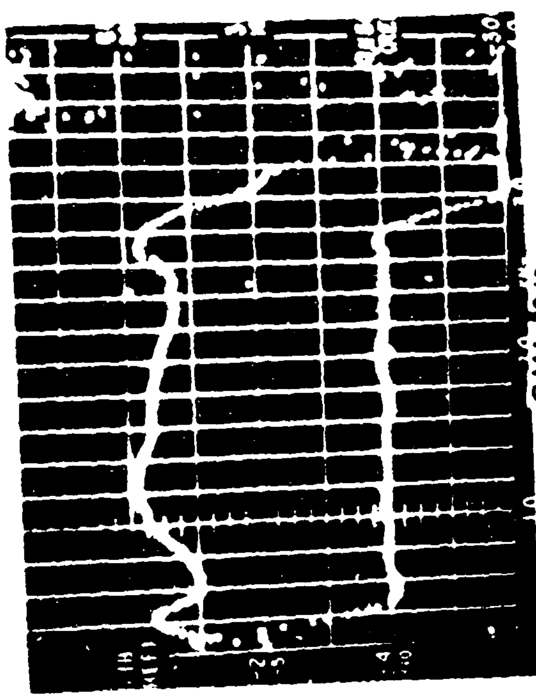

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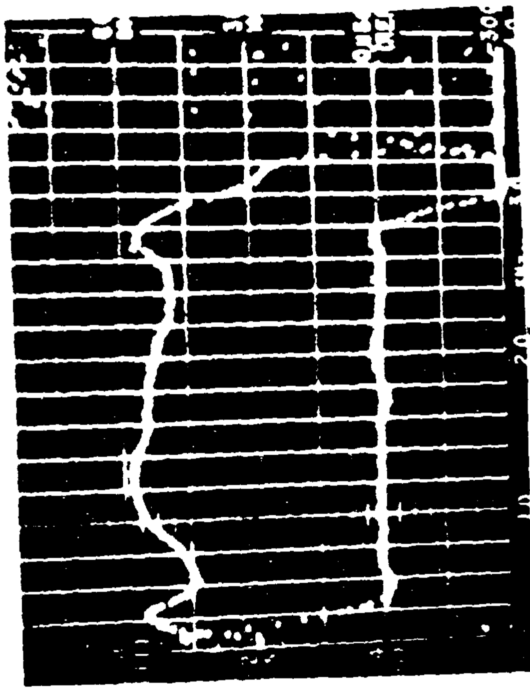

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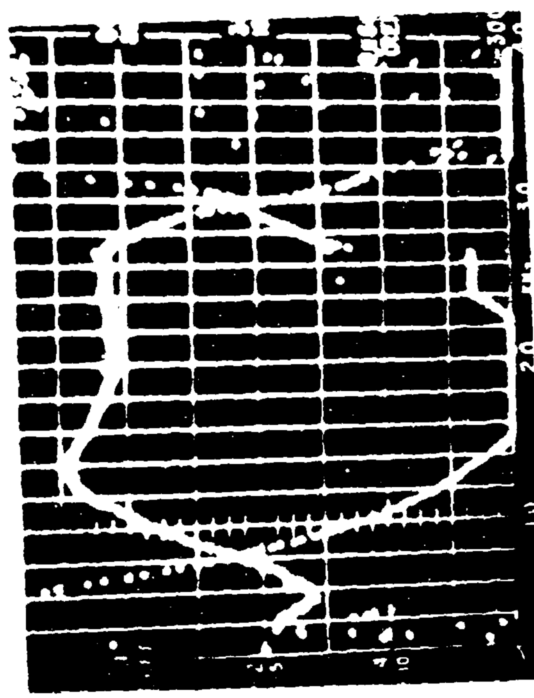

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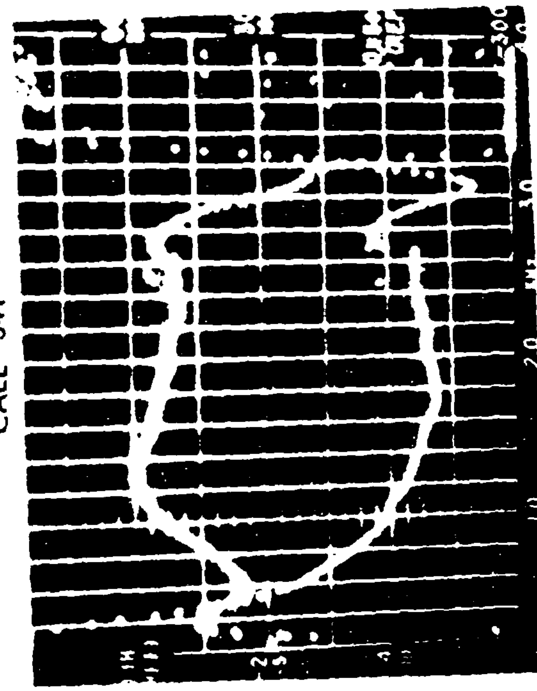

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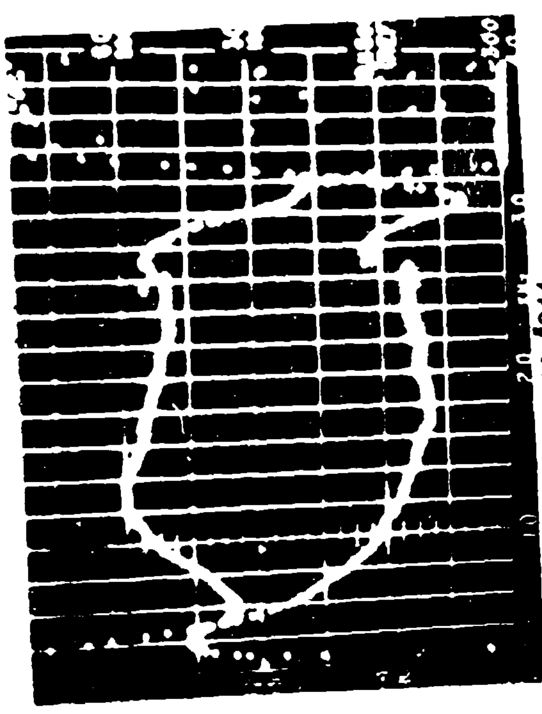

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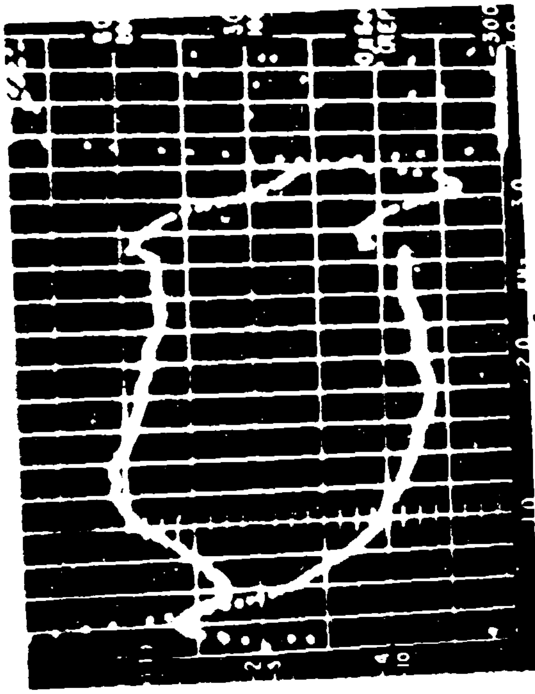

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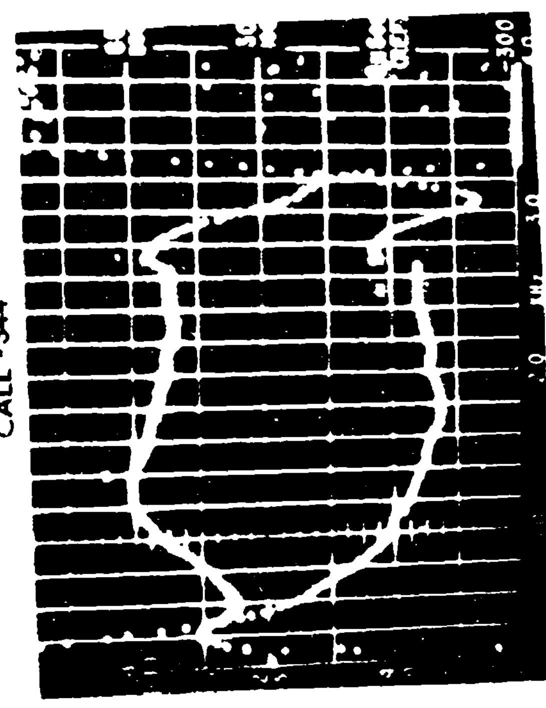

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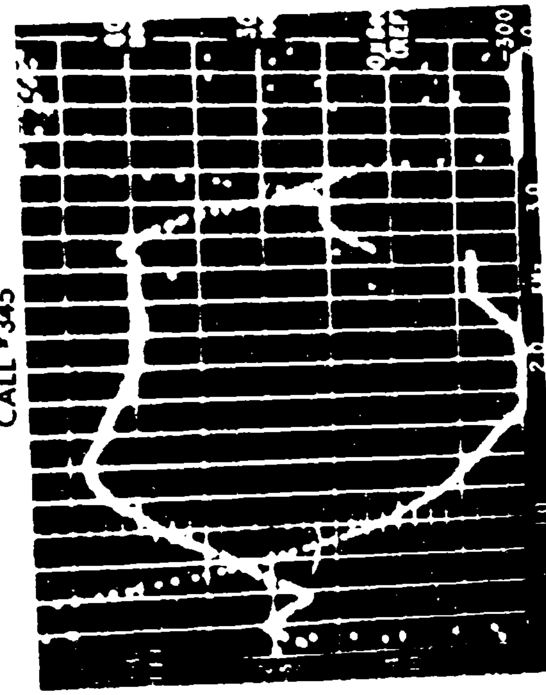

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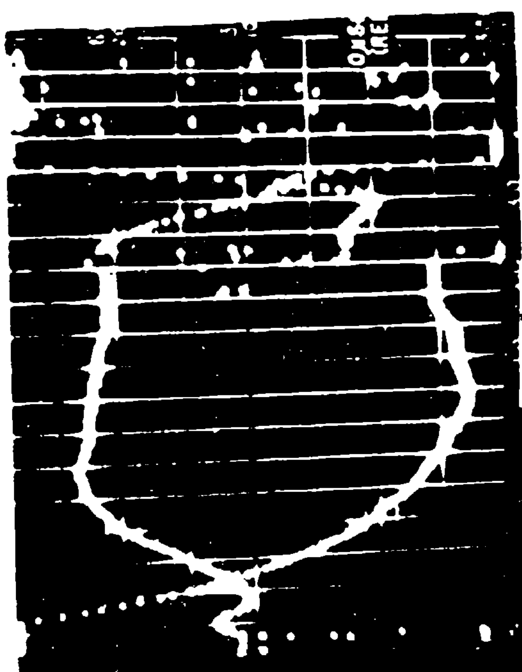

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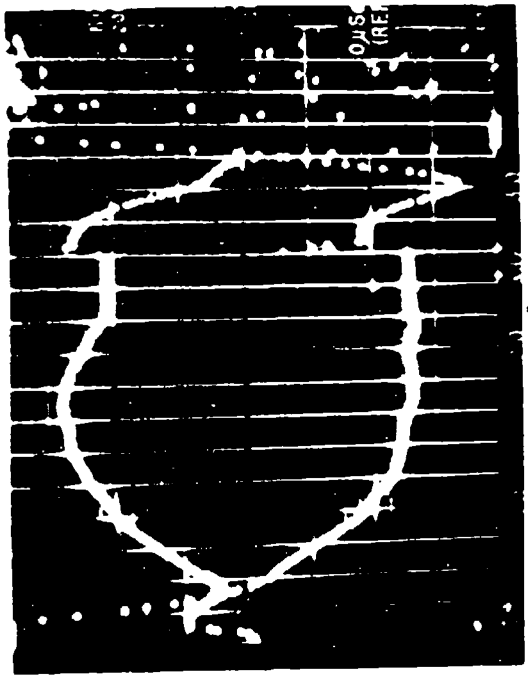

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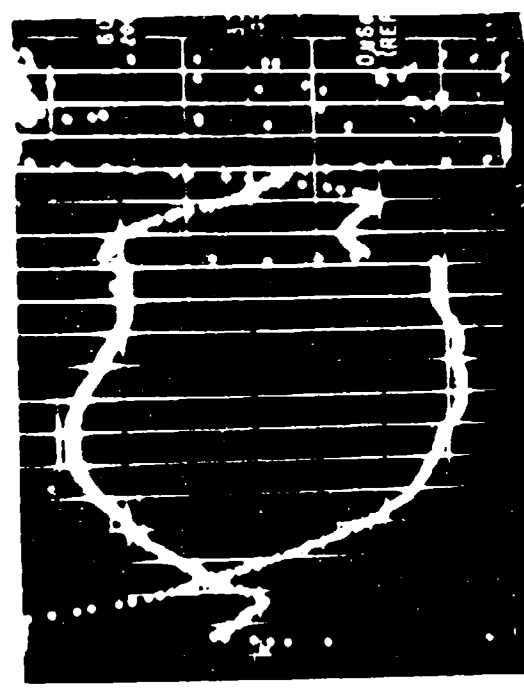

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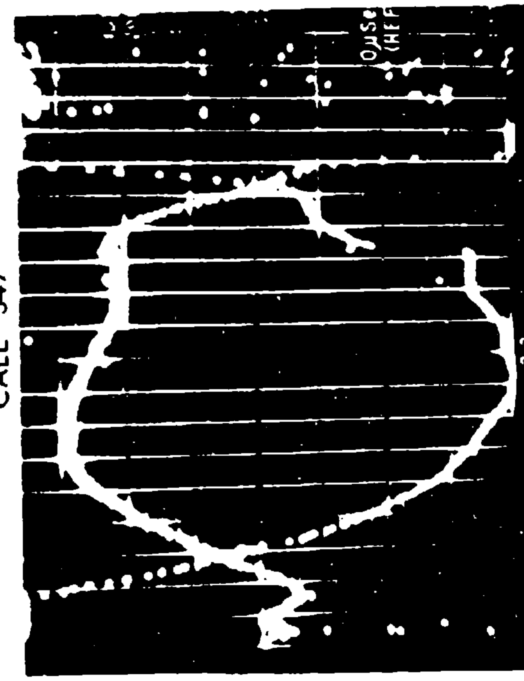

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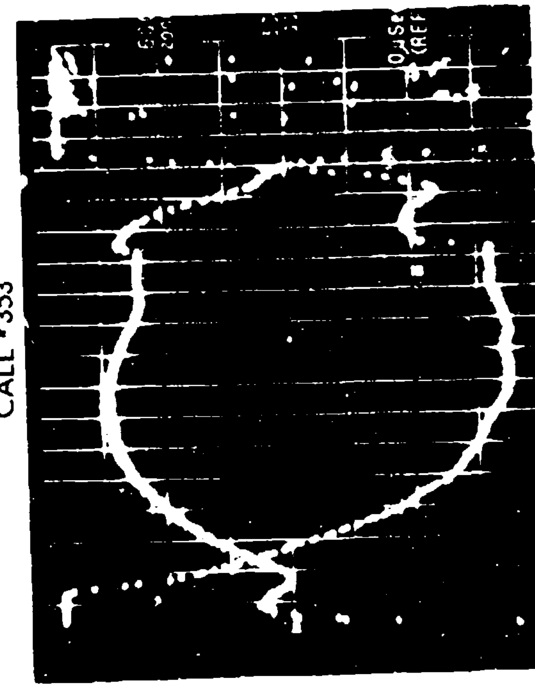
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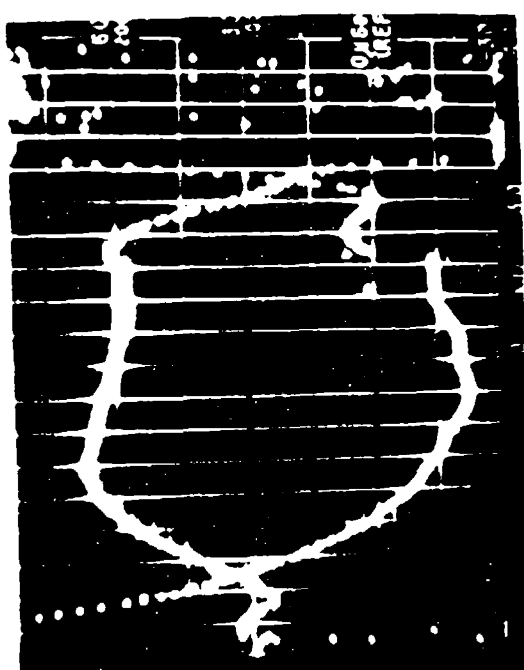
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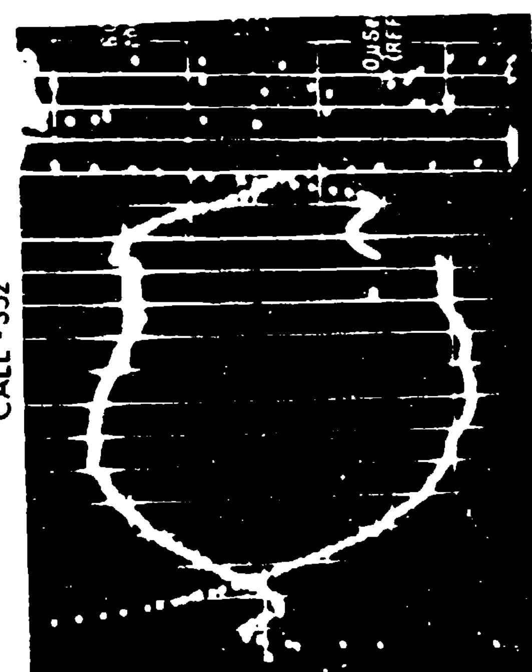
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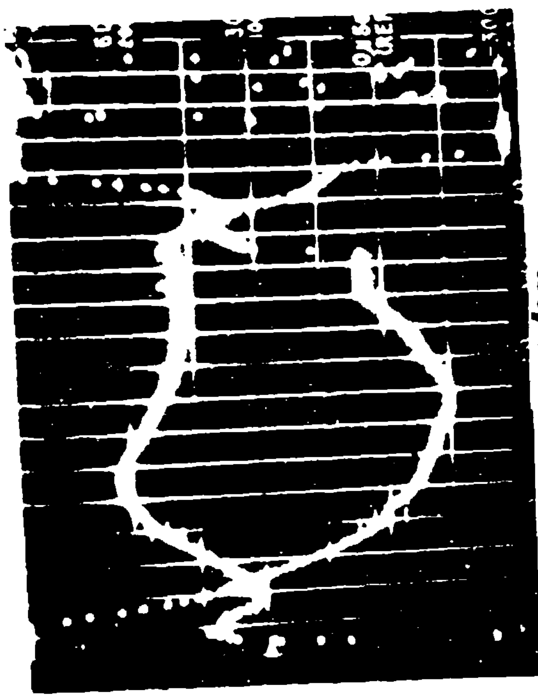

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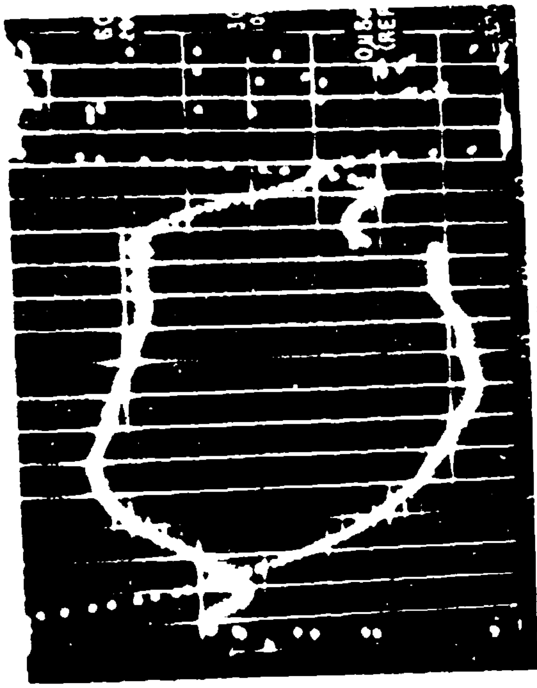

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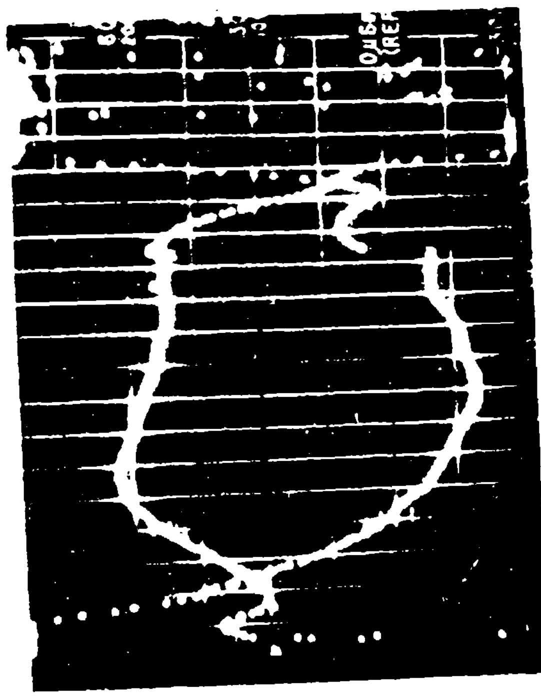

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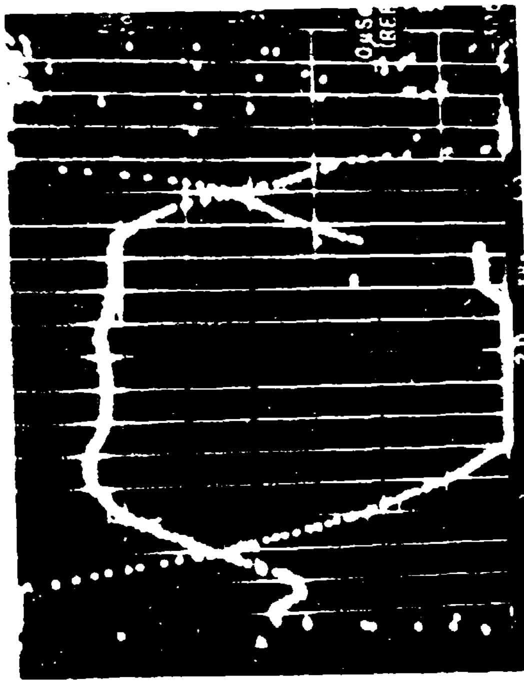
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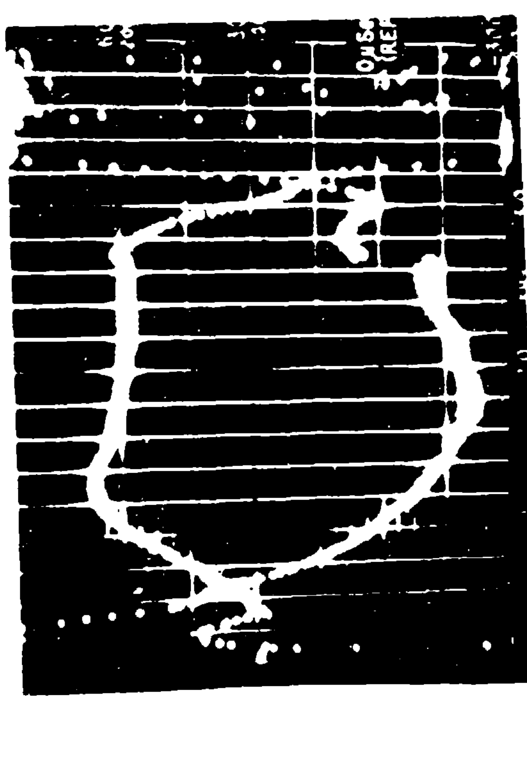
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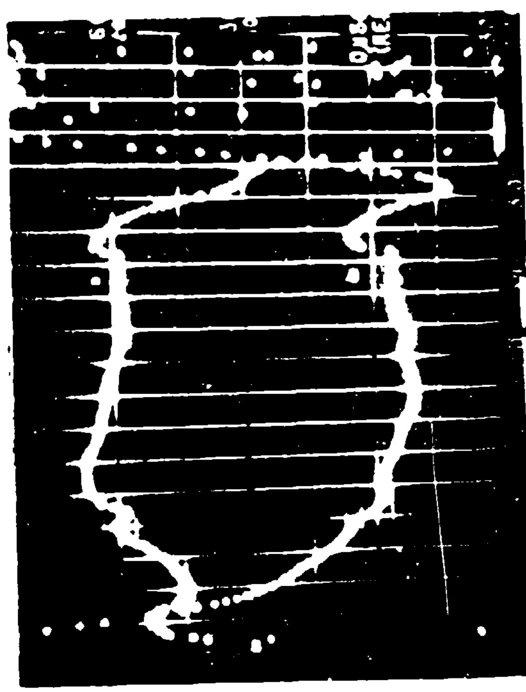

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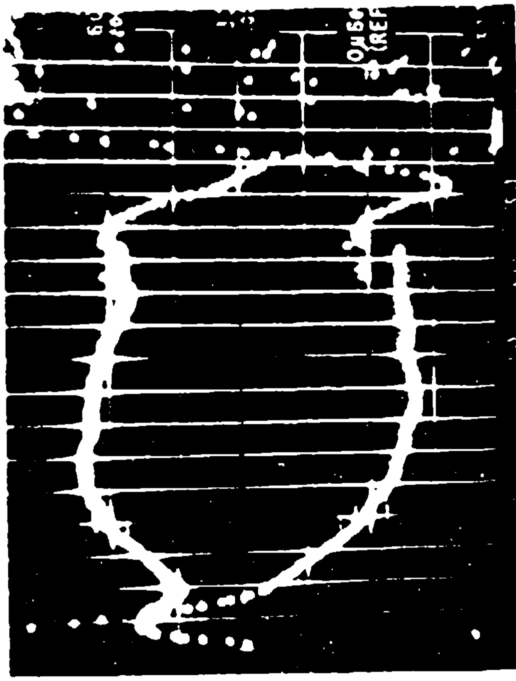

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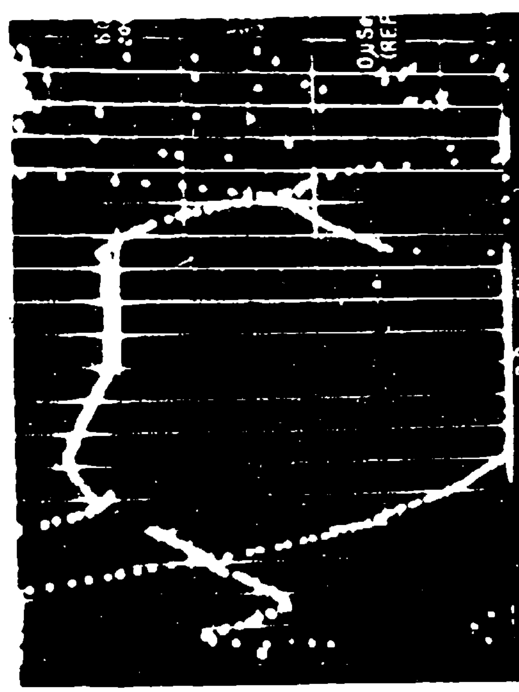

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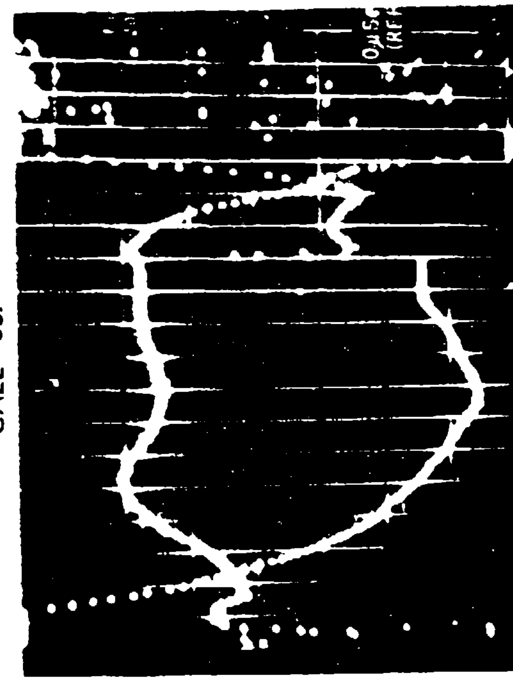

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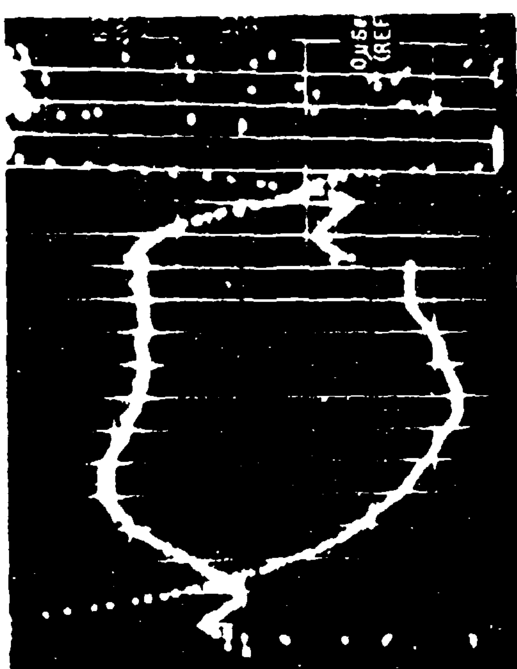

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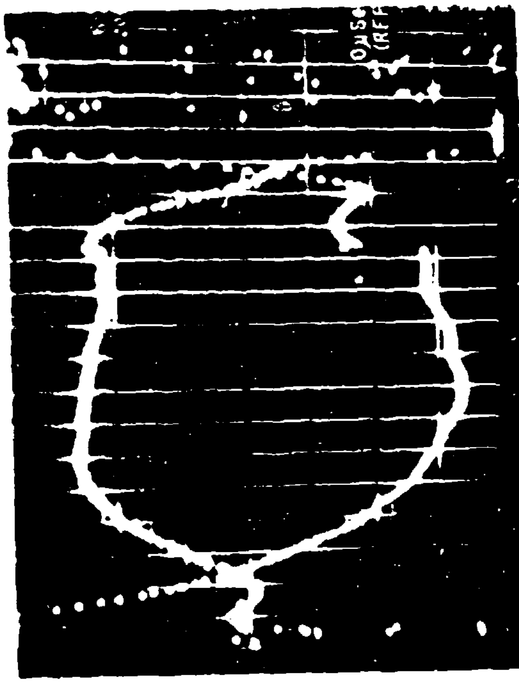

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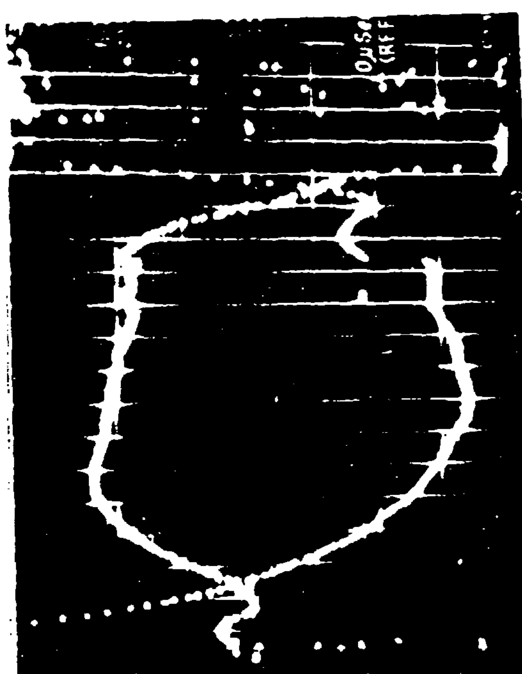

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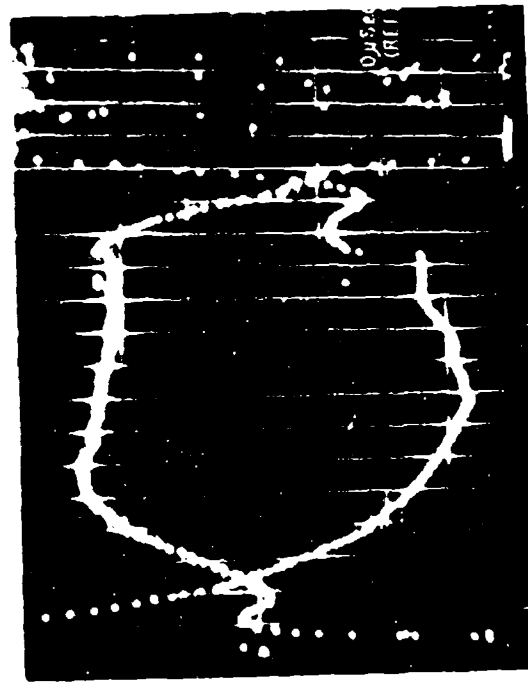

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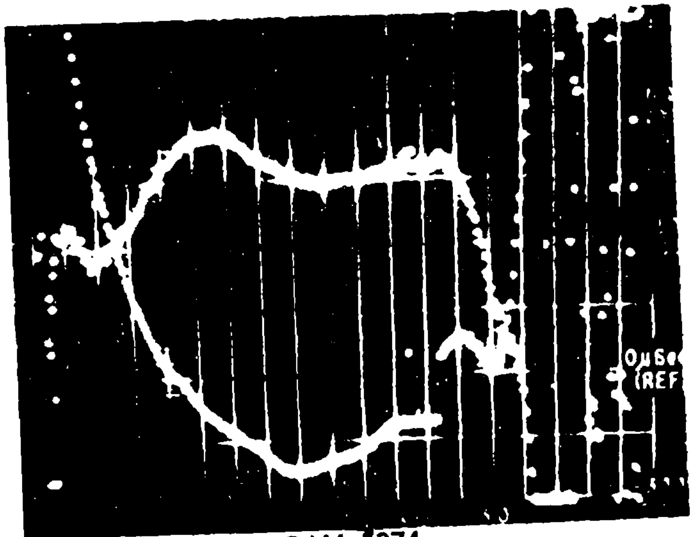

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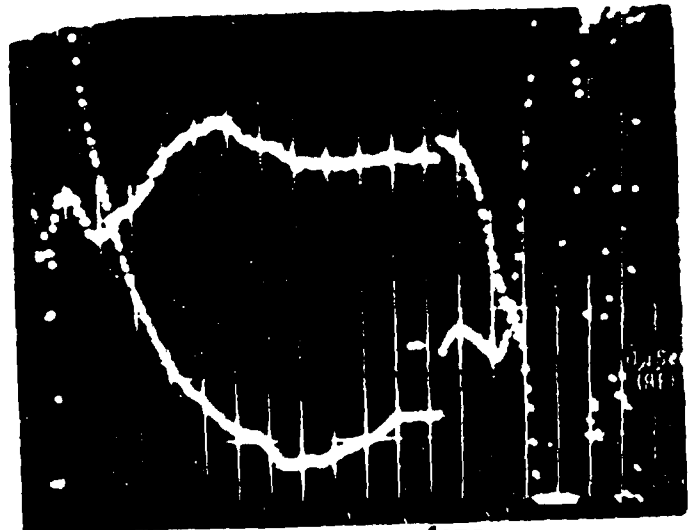

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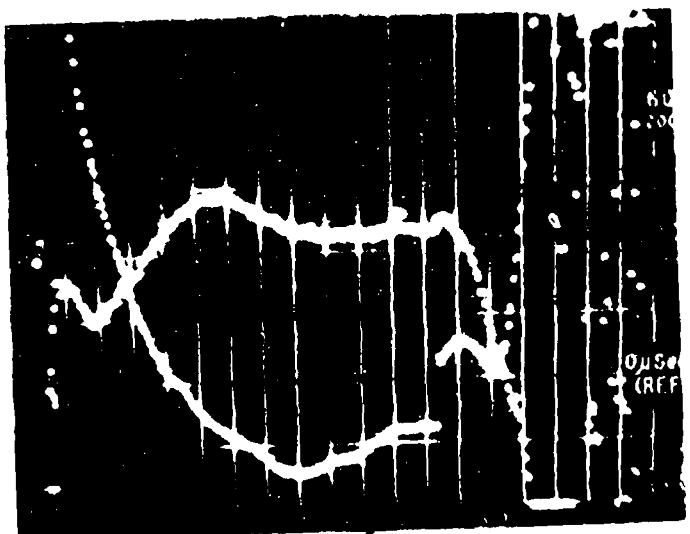

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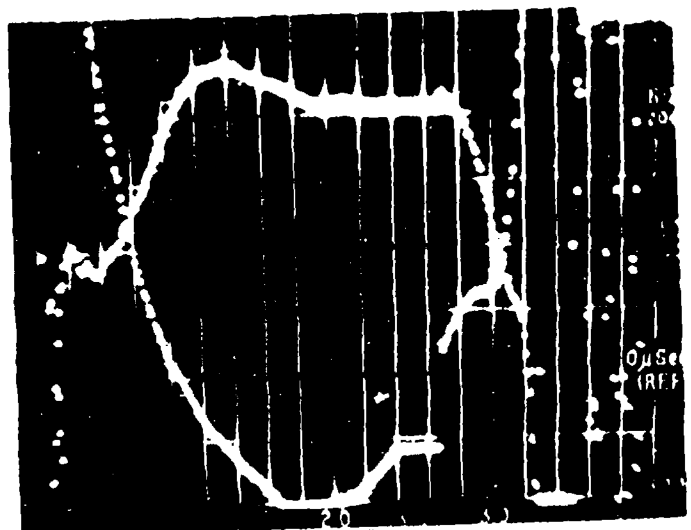

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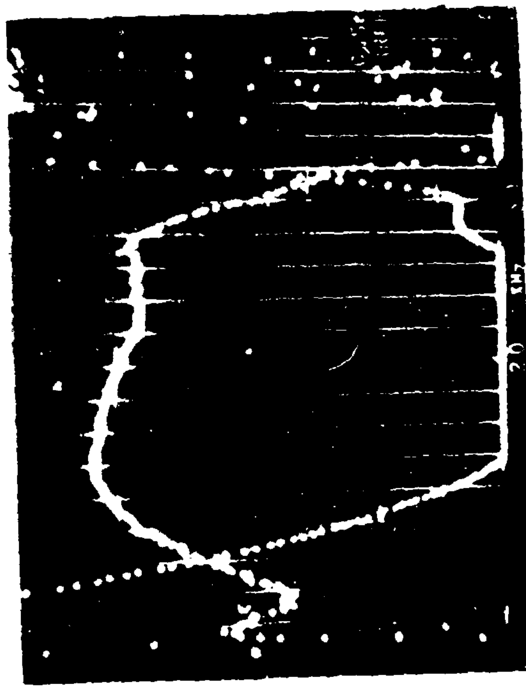

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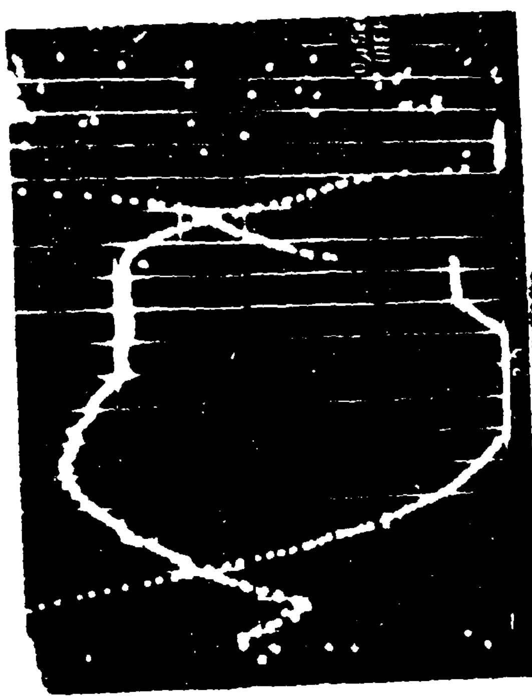

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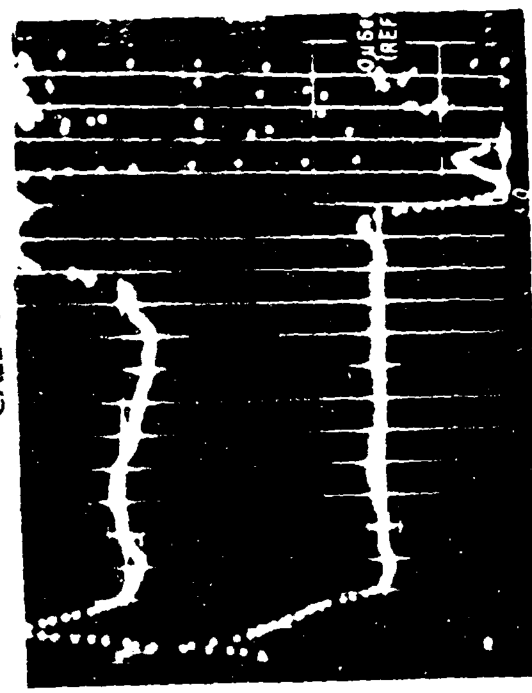

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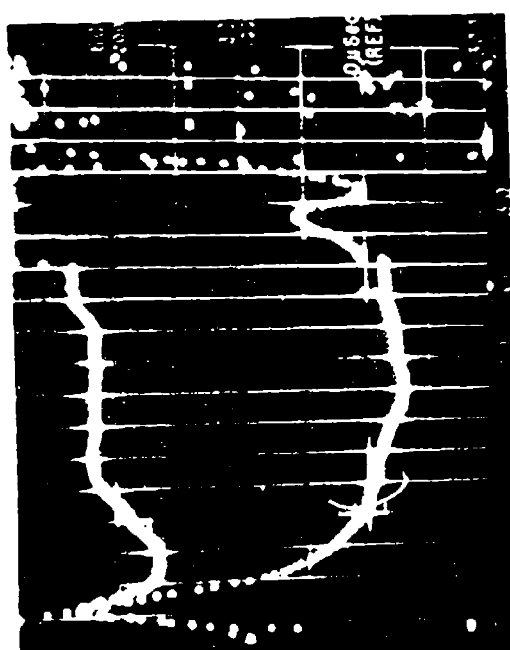

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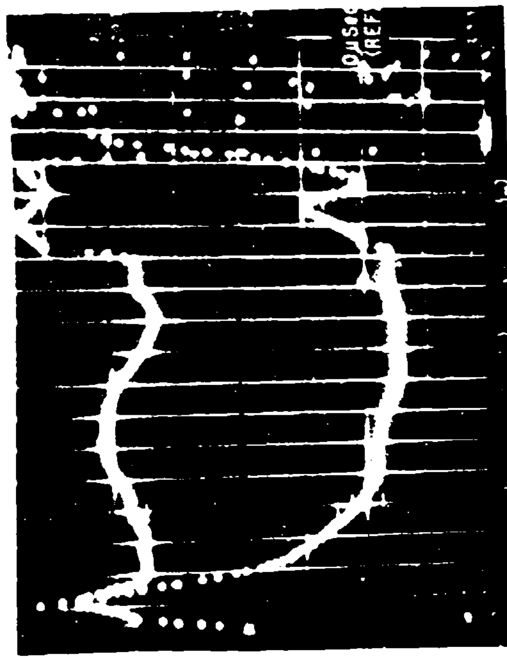

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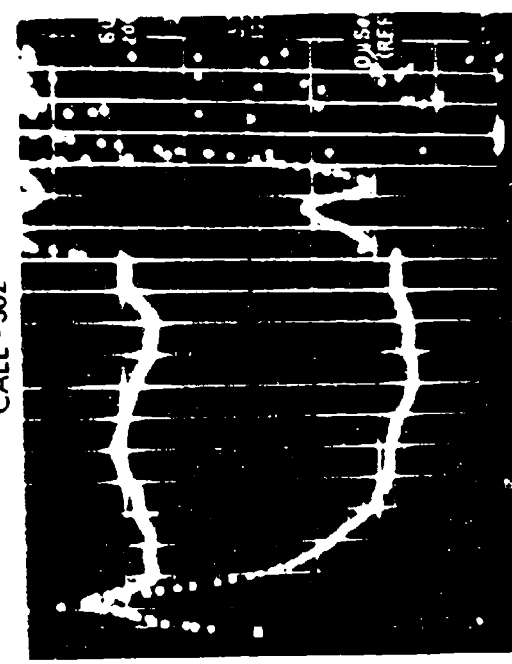

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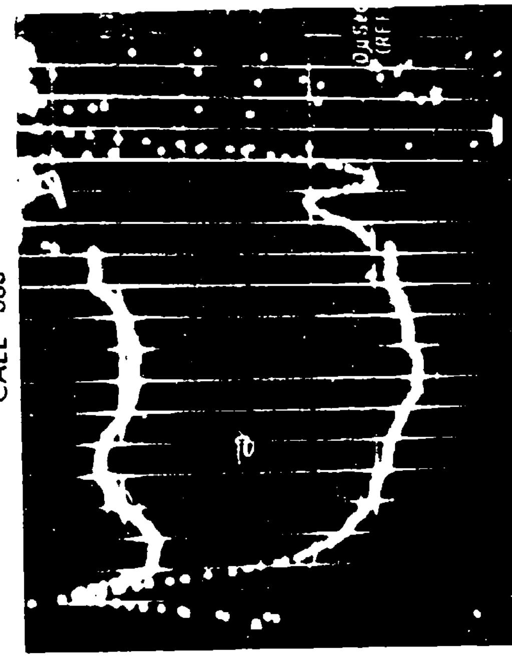

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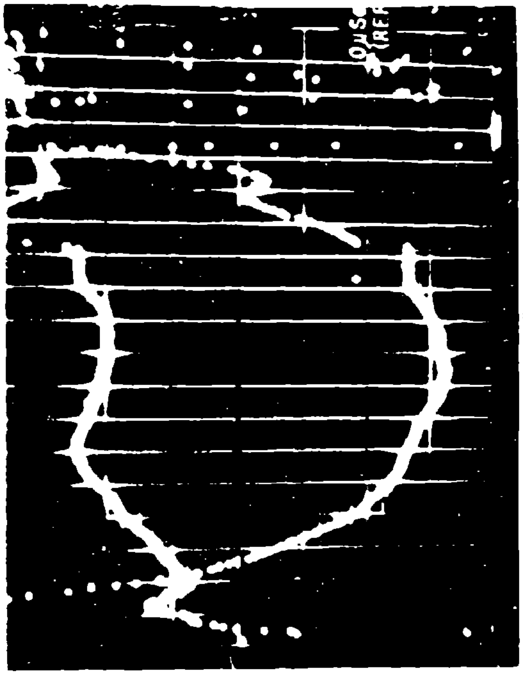

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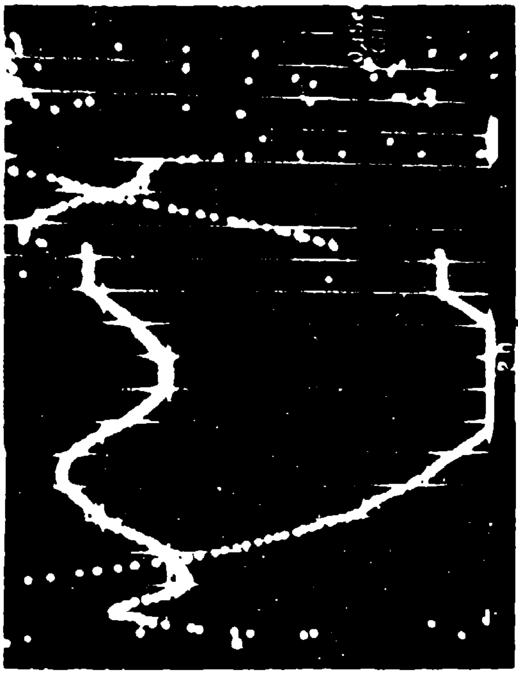

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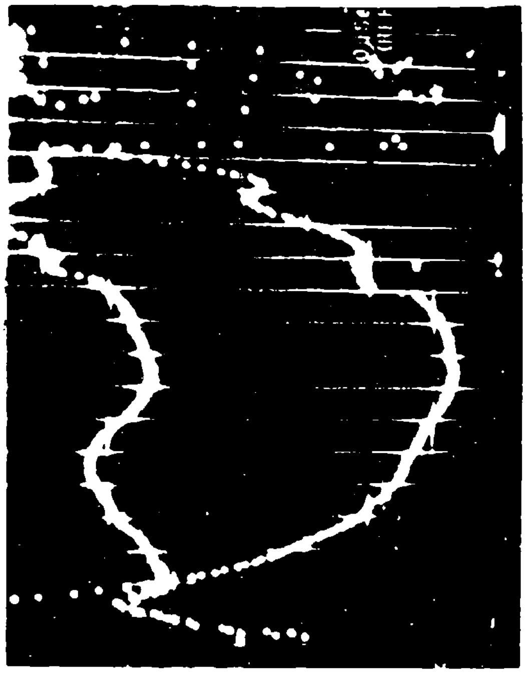

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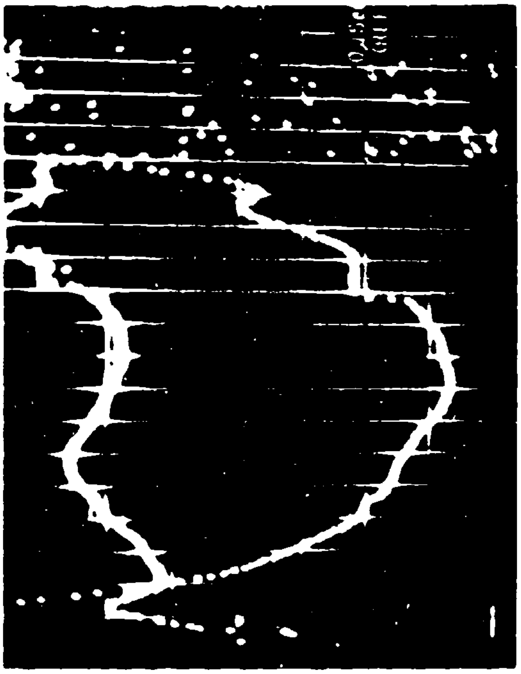

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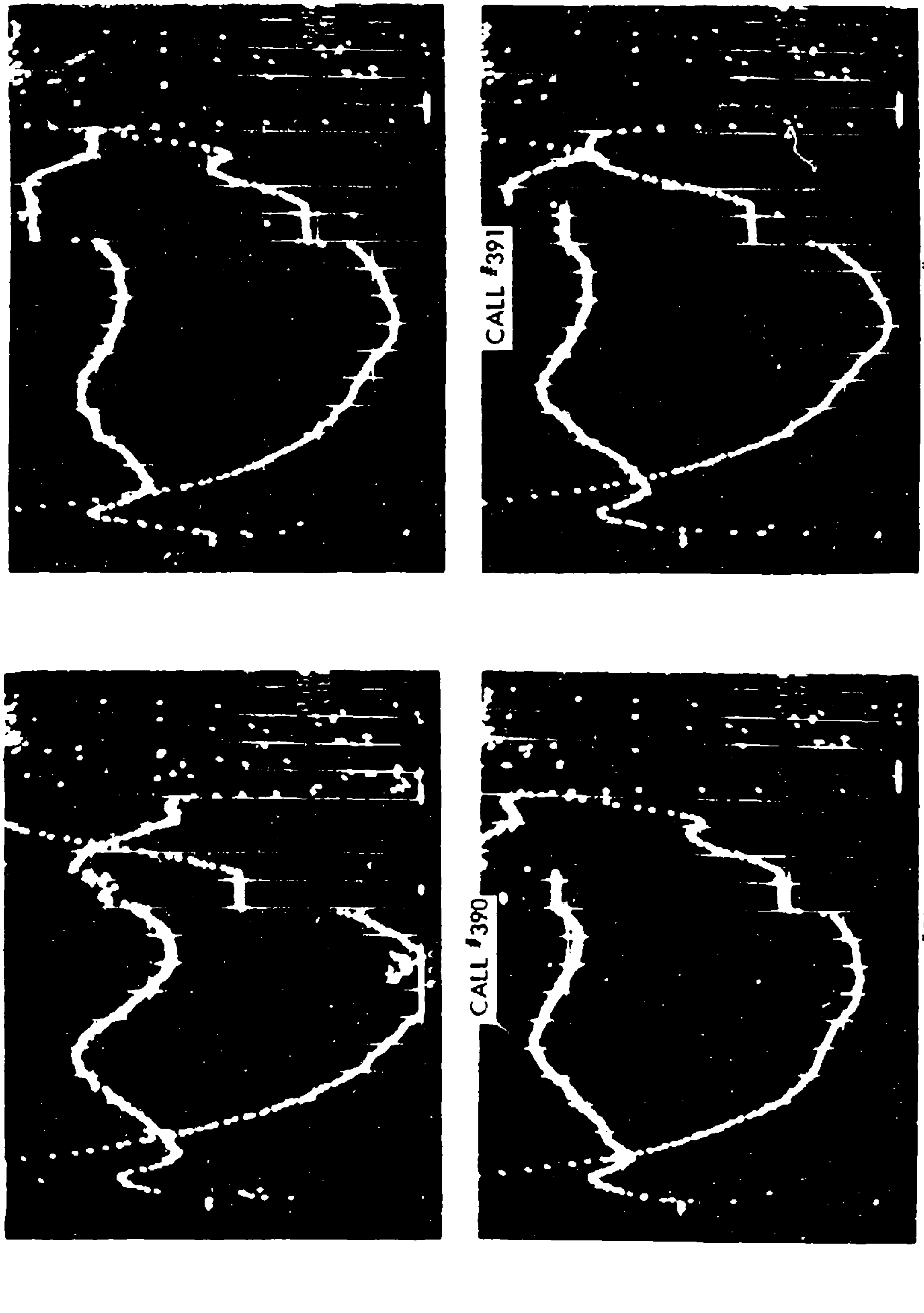
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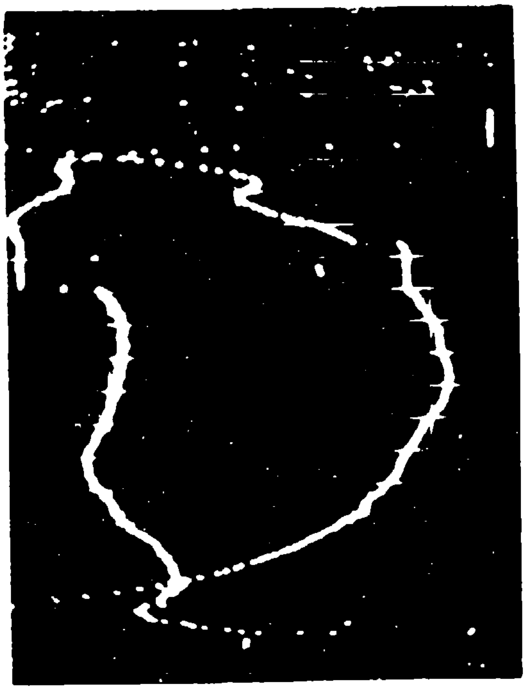

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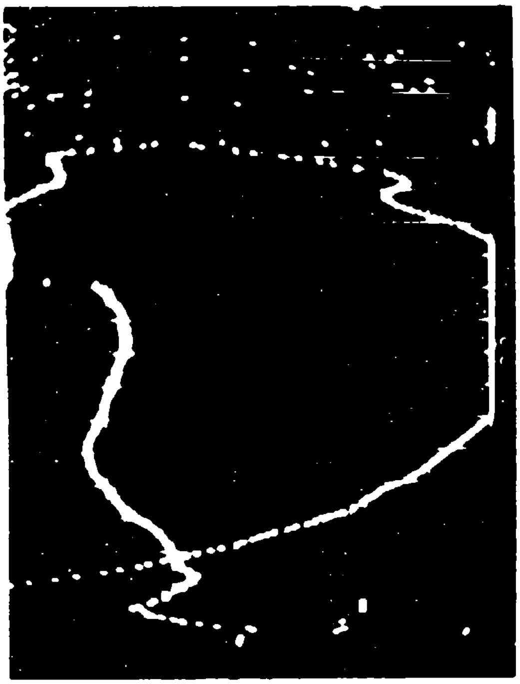

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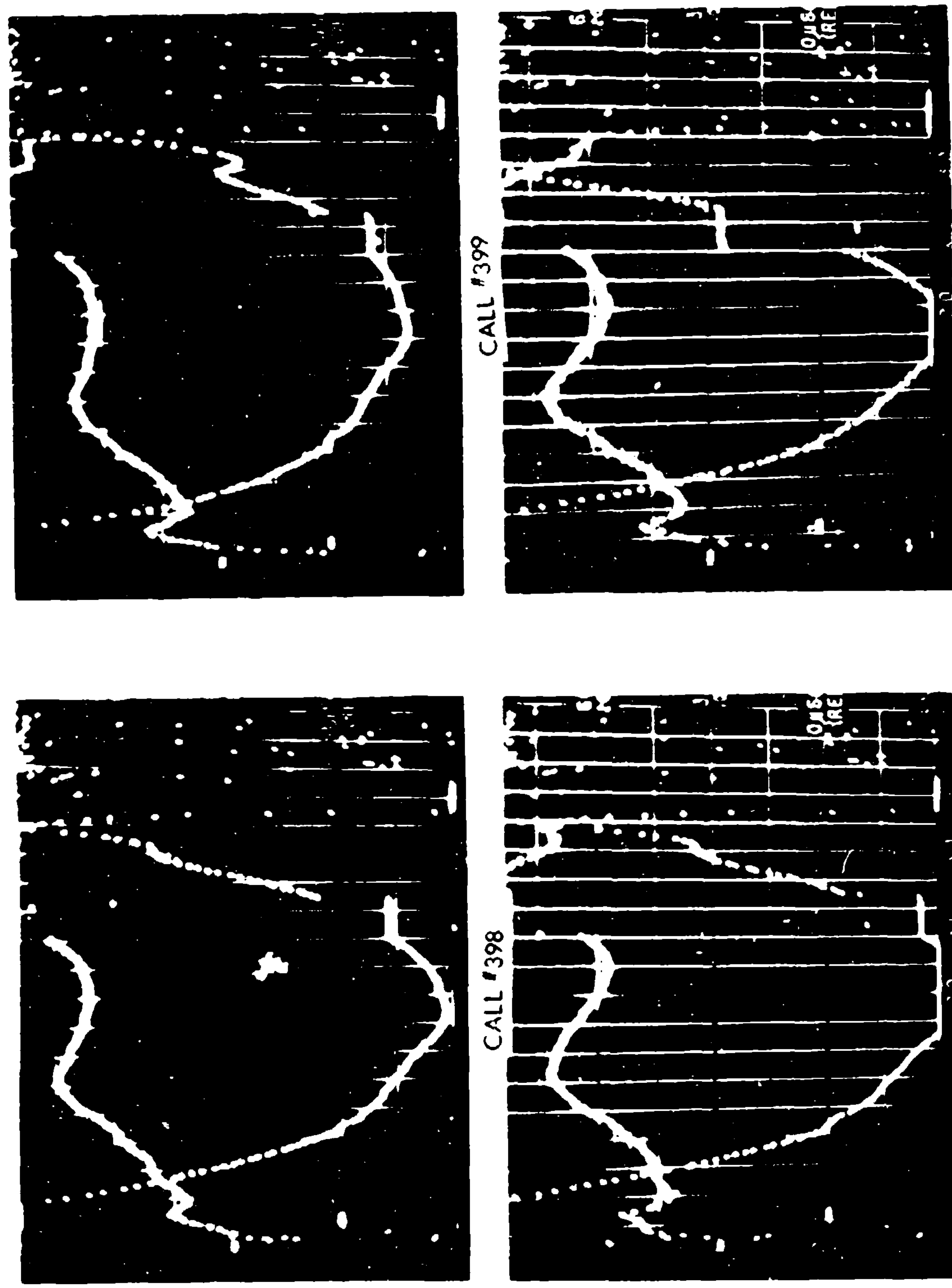
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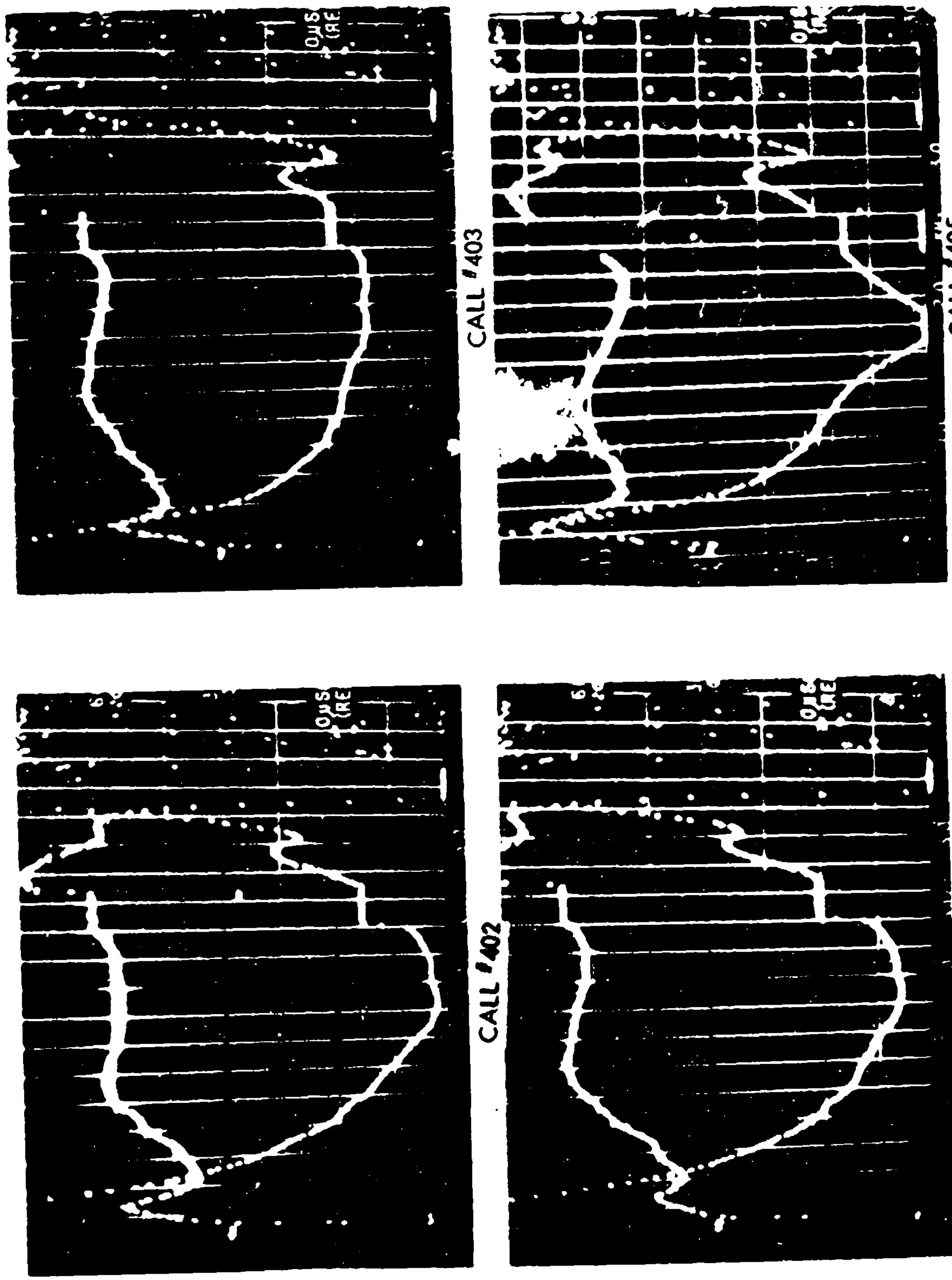
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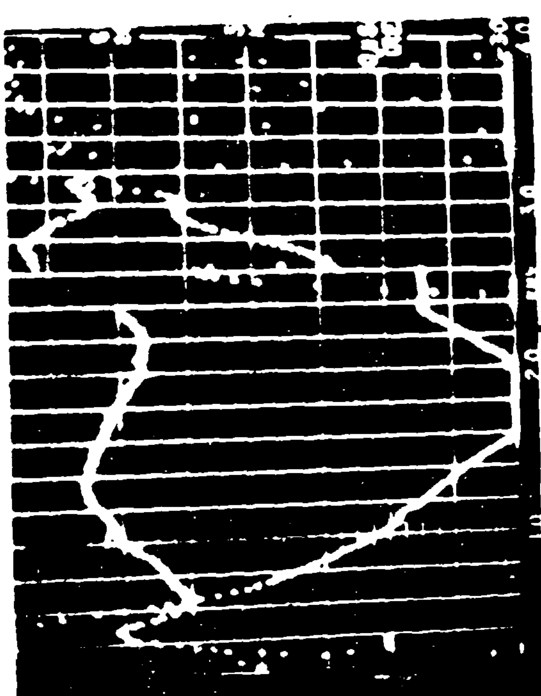

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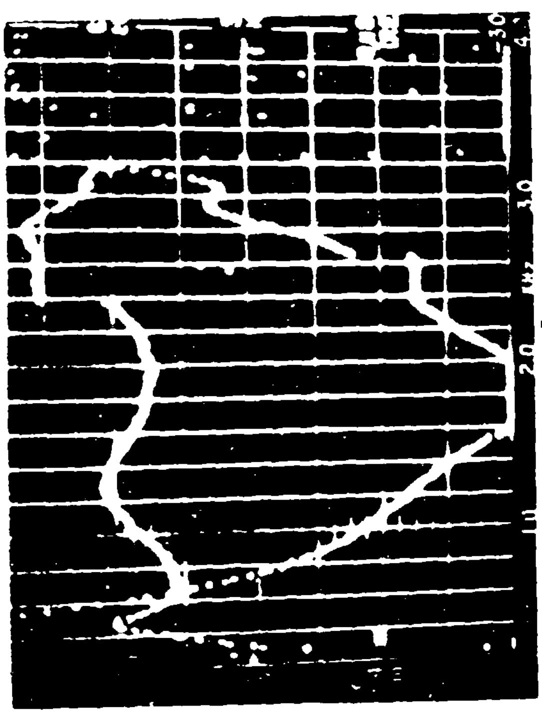

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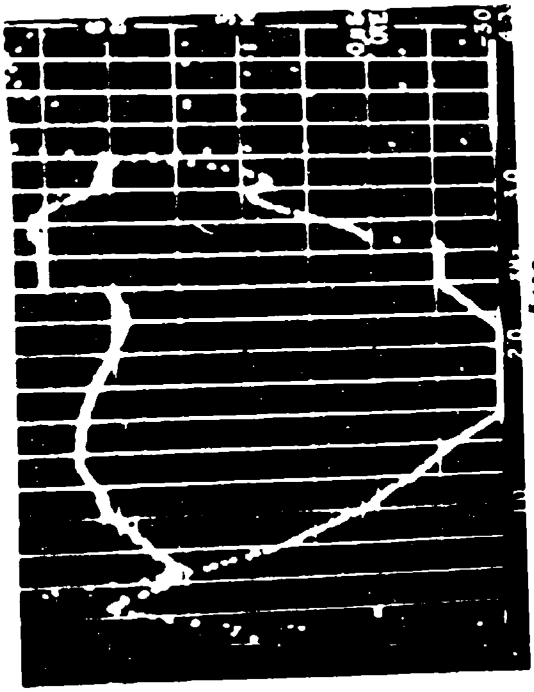

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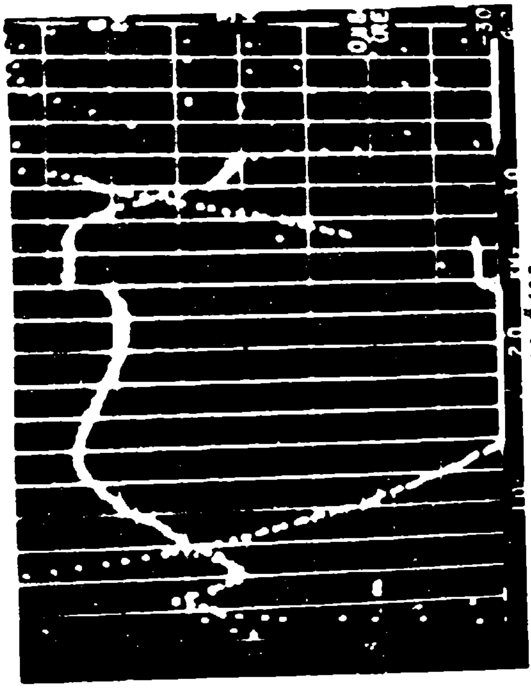

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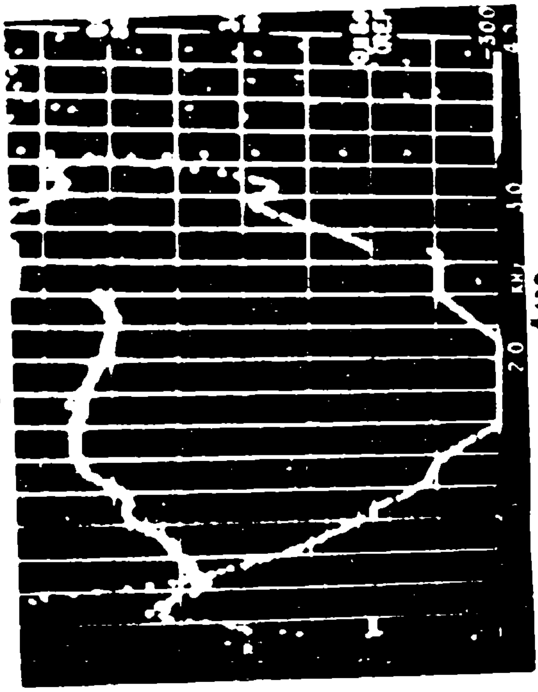

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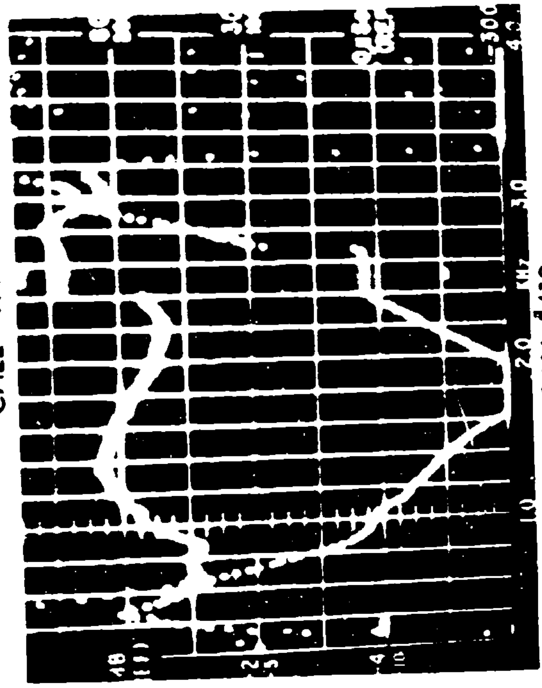

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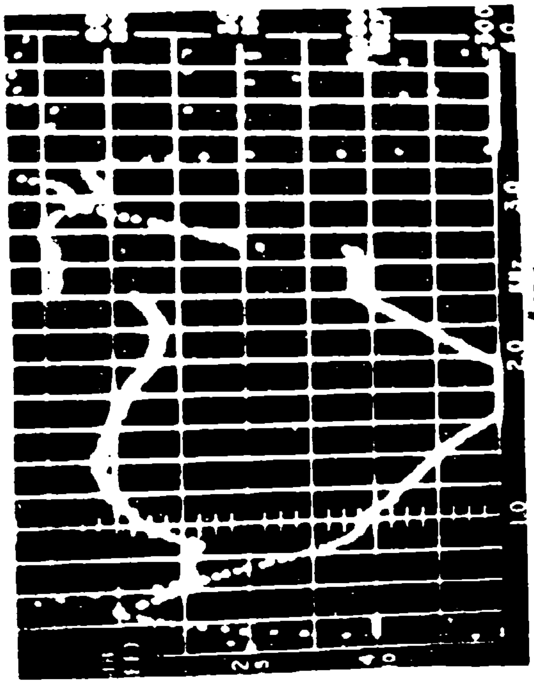

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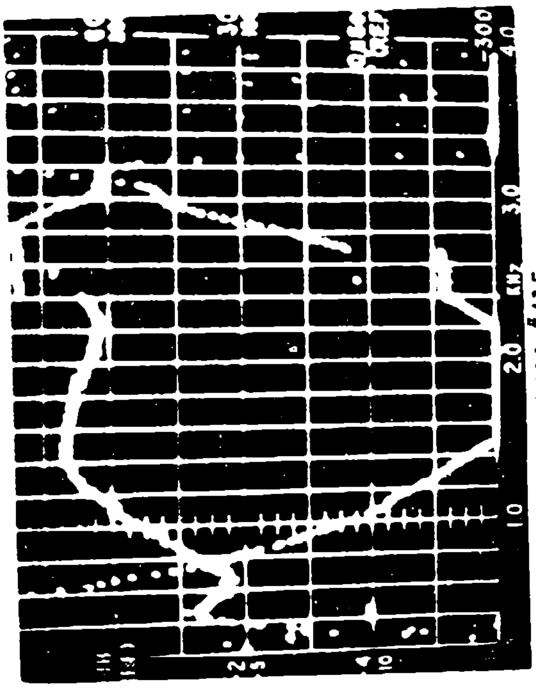

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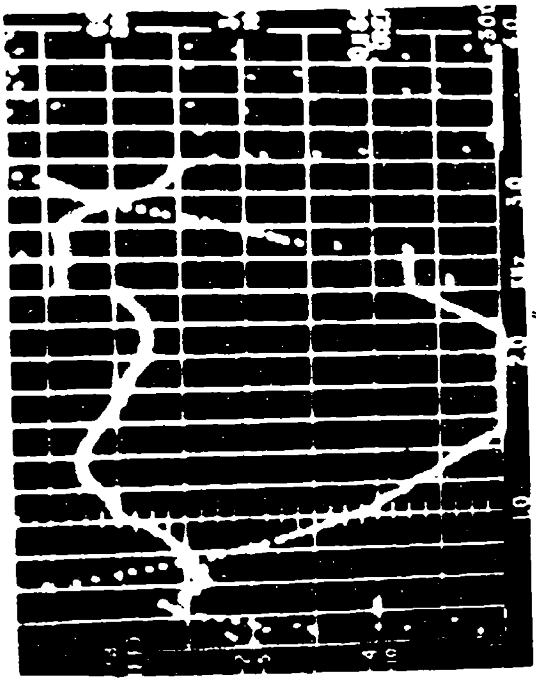

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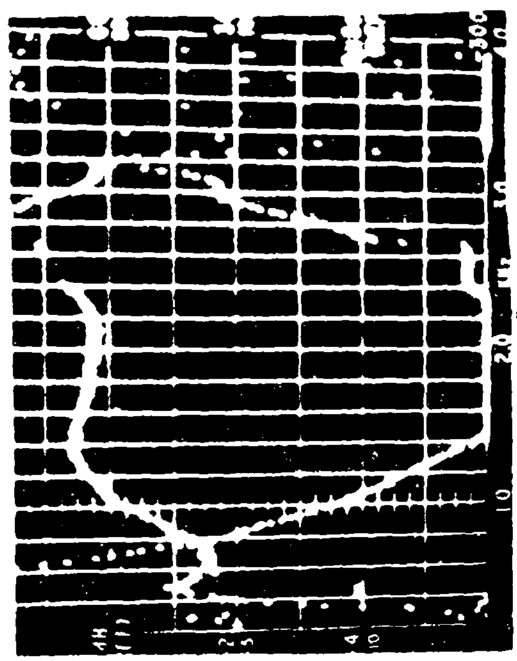

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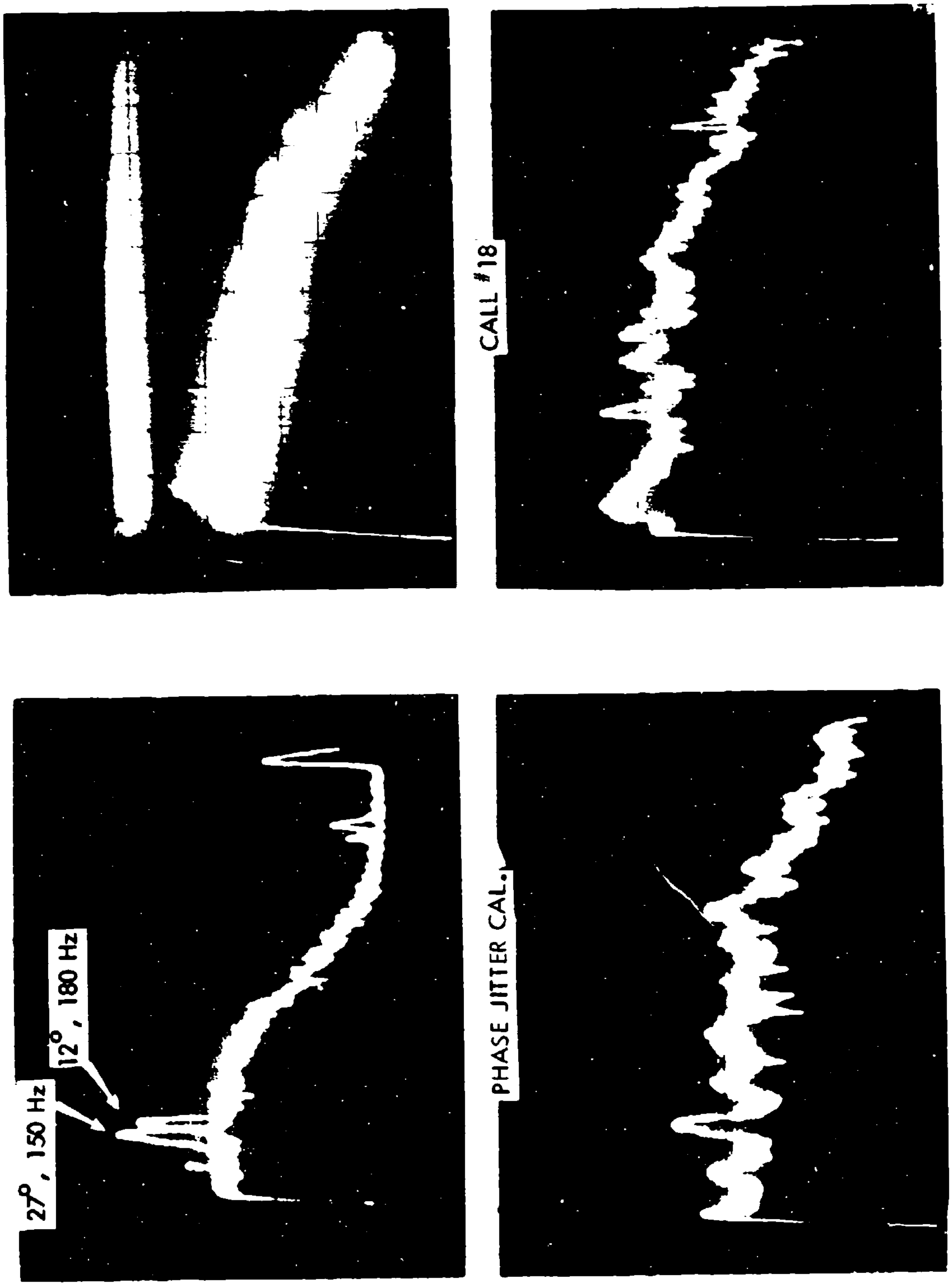
PHASE JITTER PHOTOGRAPHS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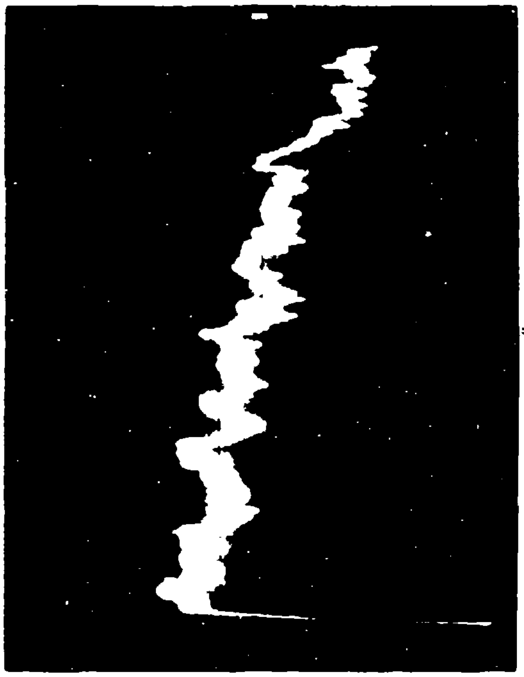

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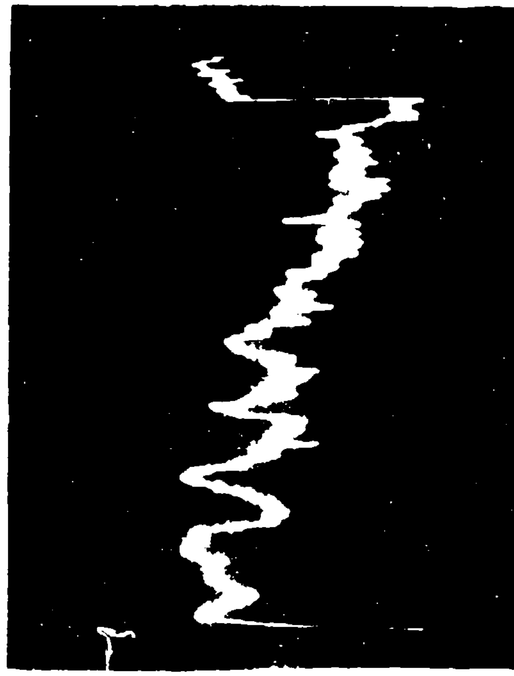

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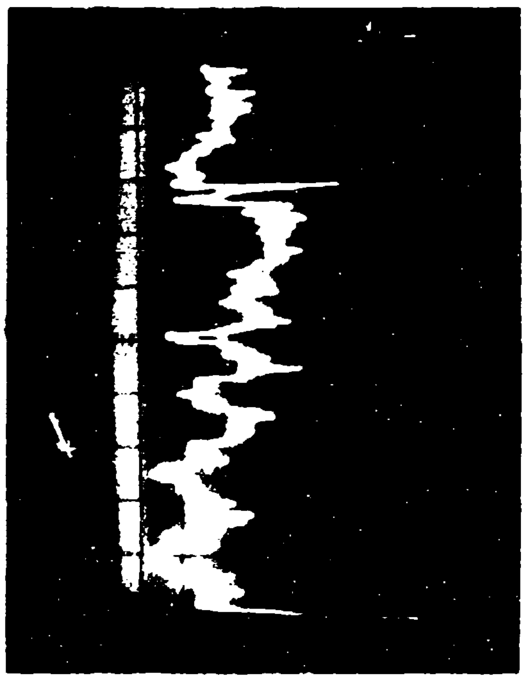

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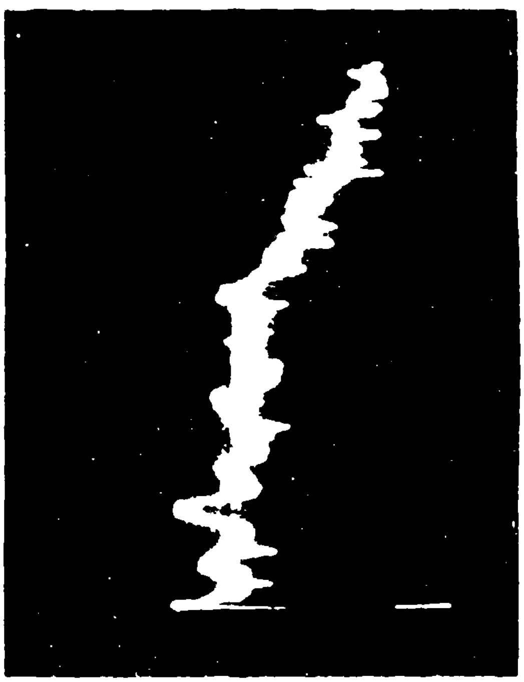

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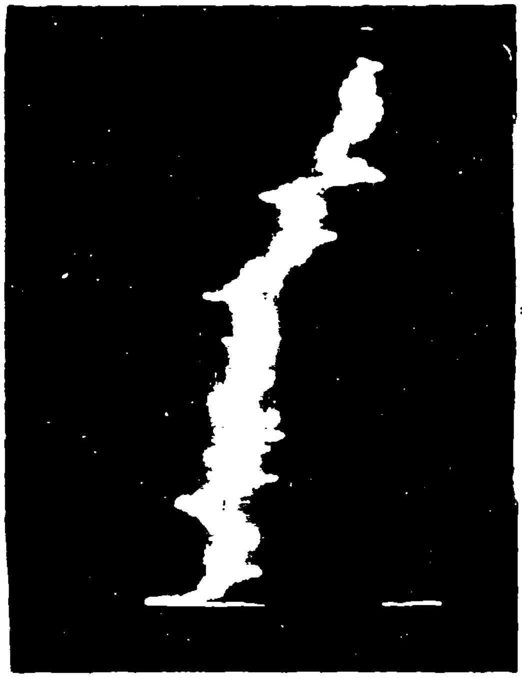

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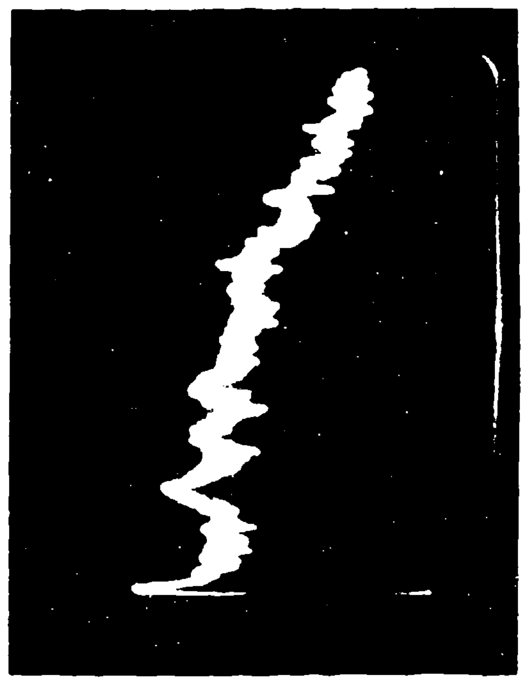

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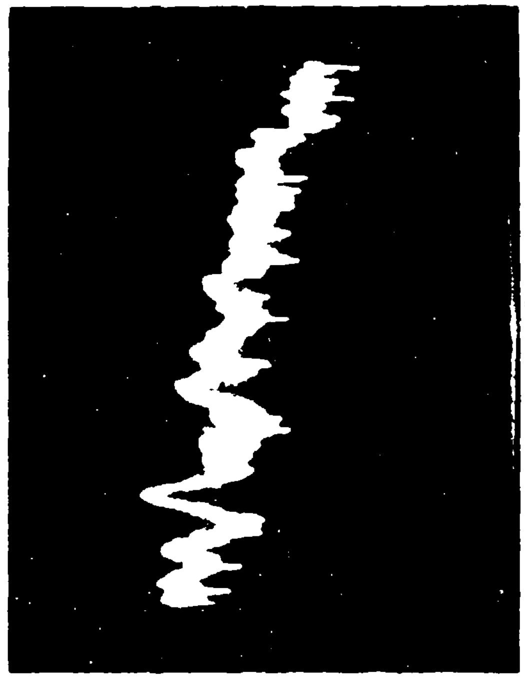

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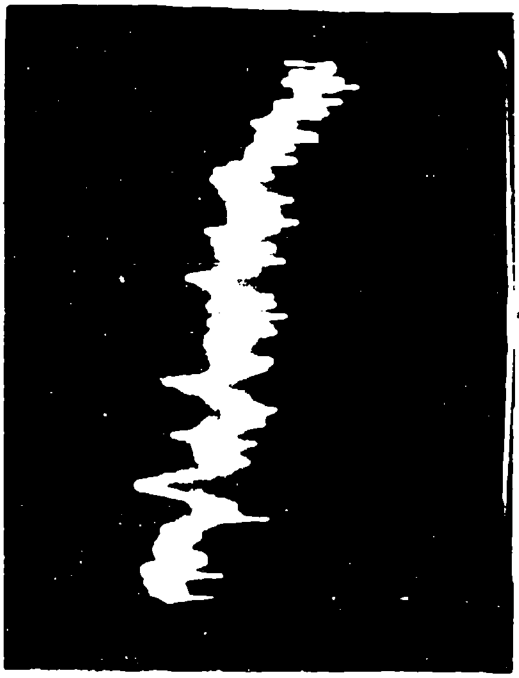
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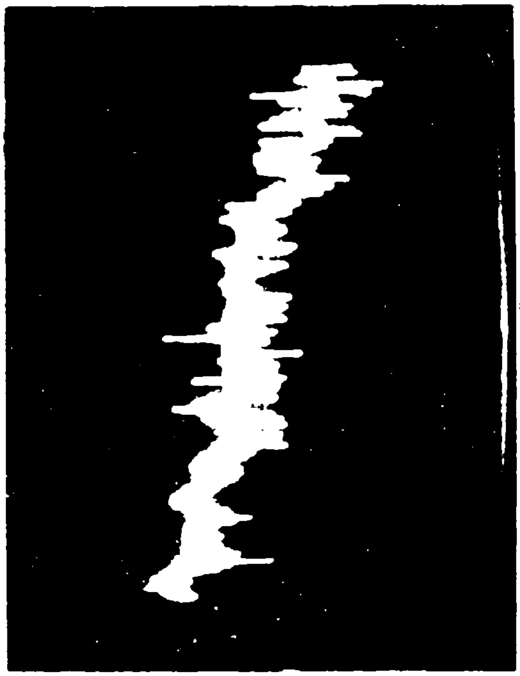
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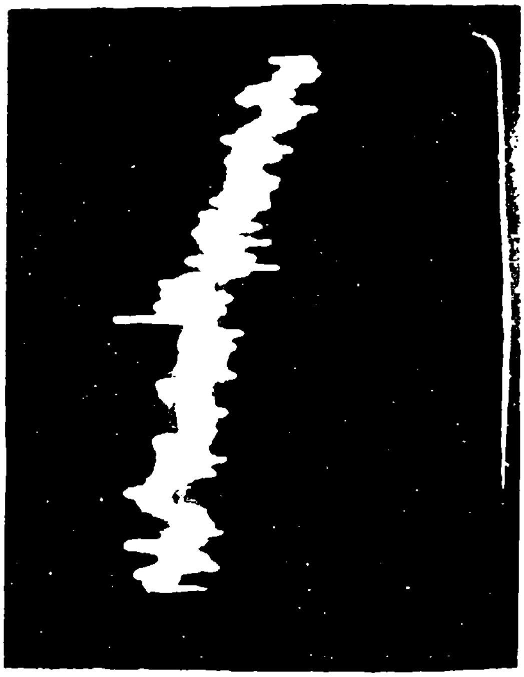
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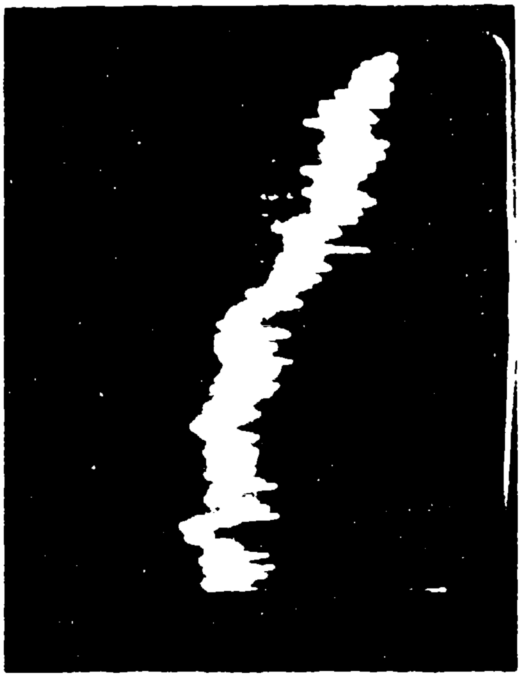
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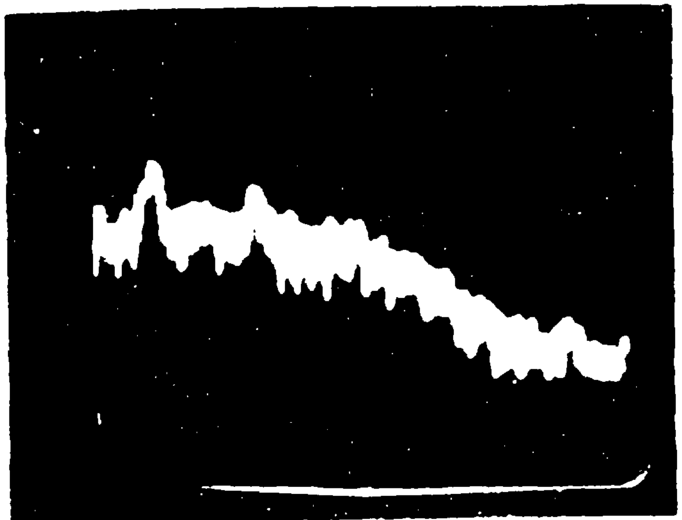

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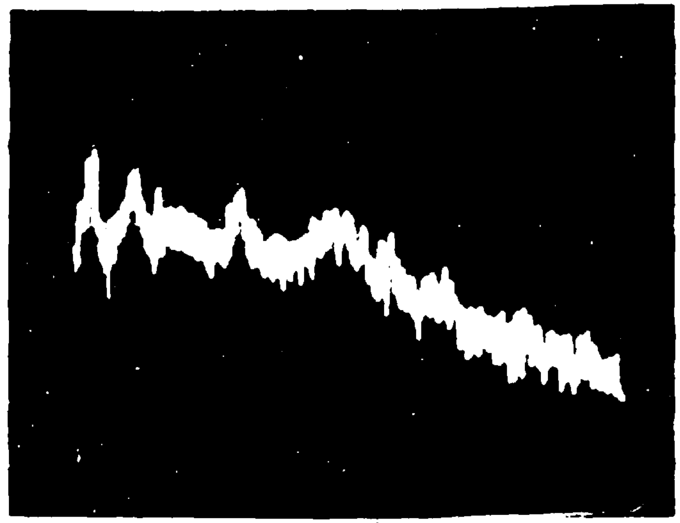

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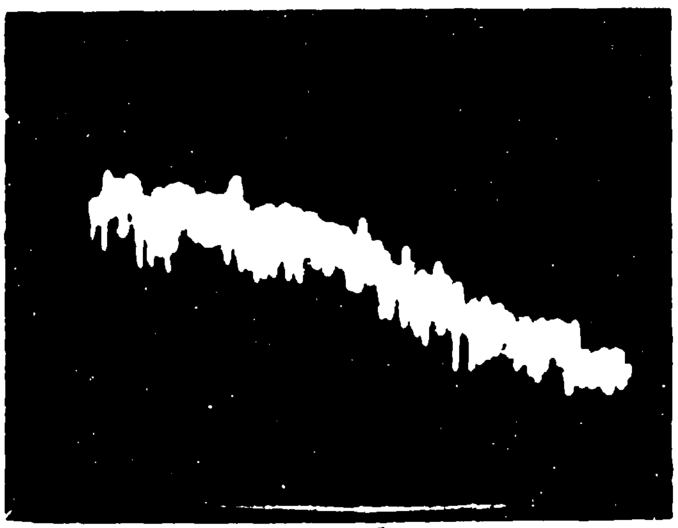

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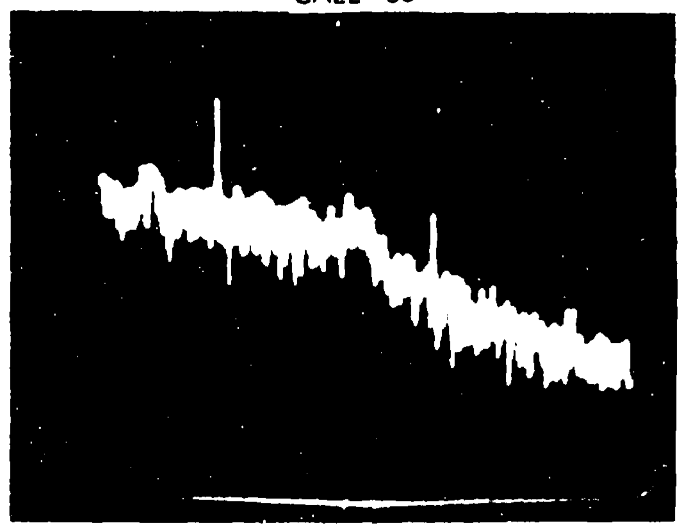

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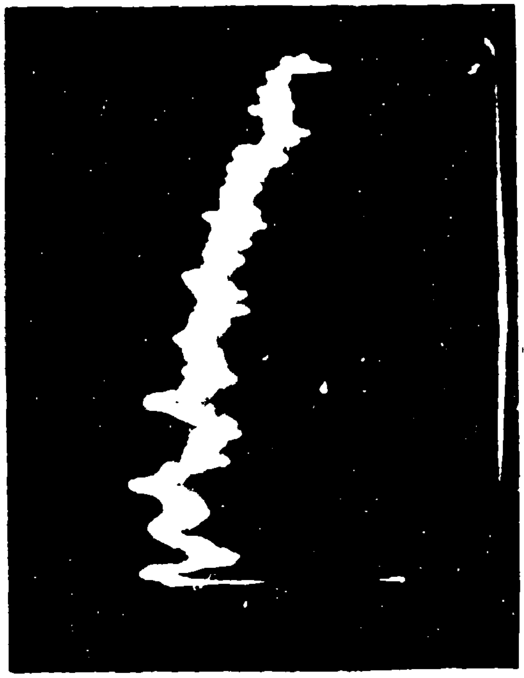

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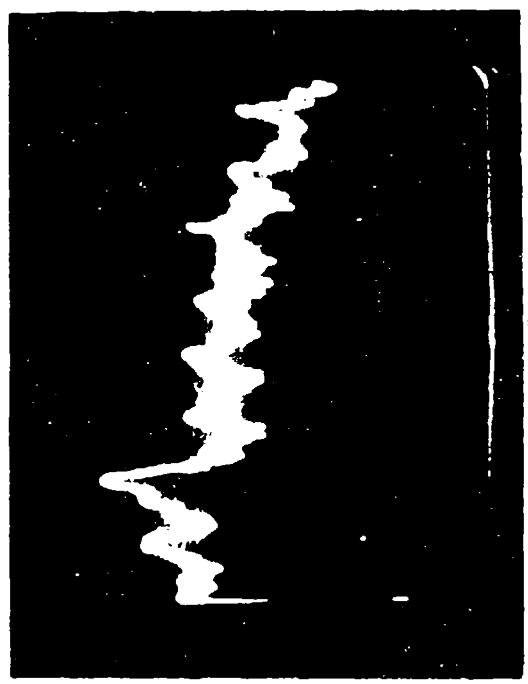

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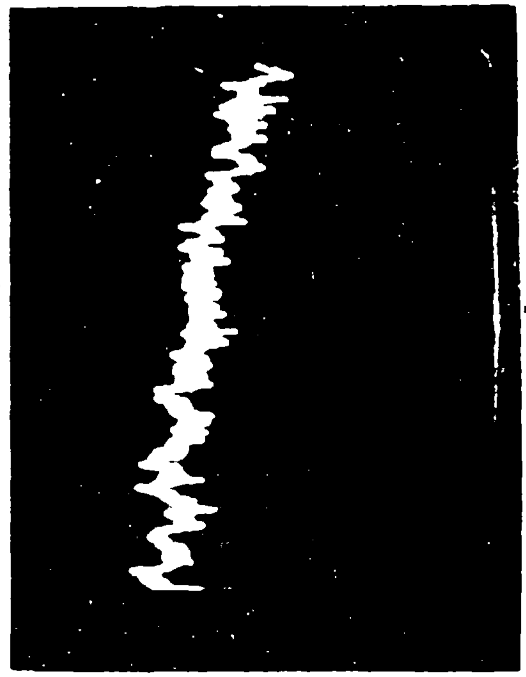

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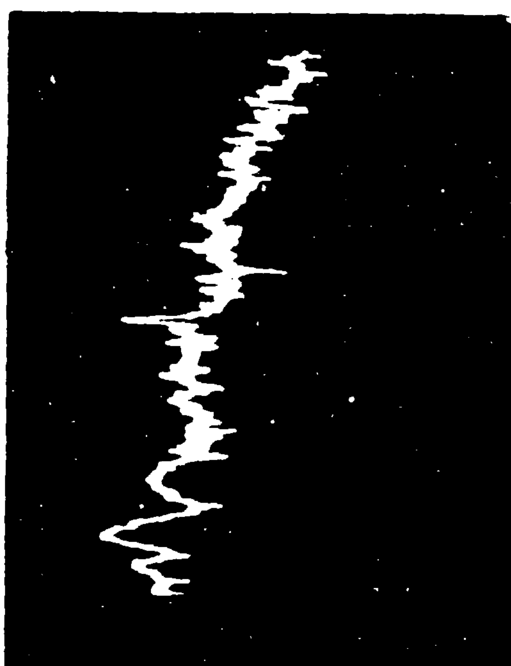

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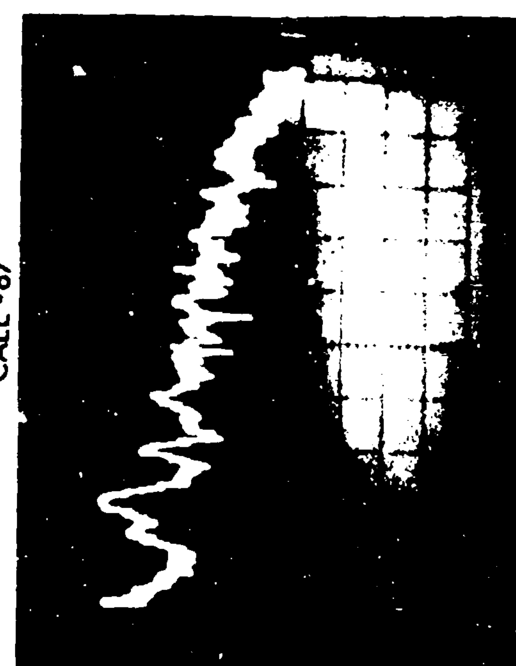

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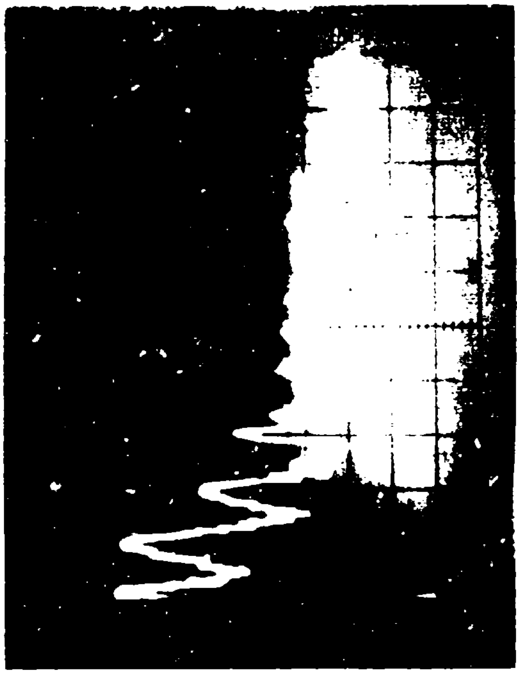

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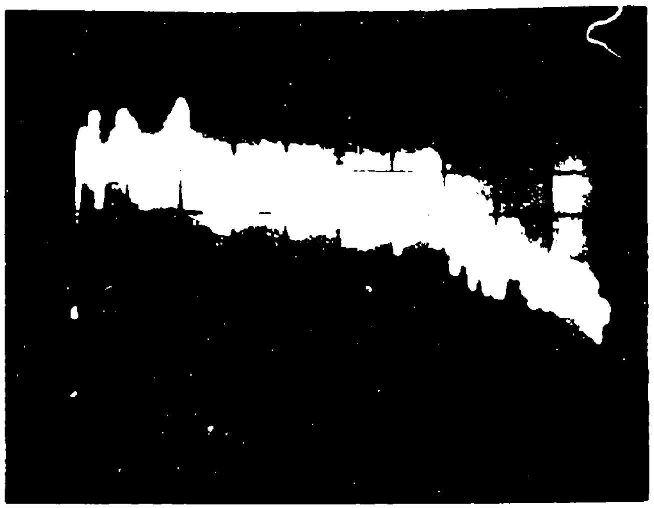

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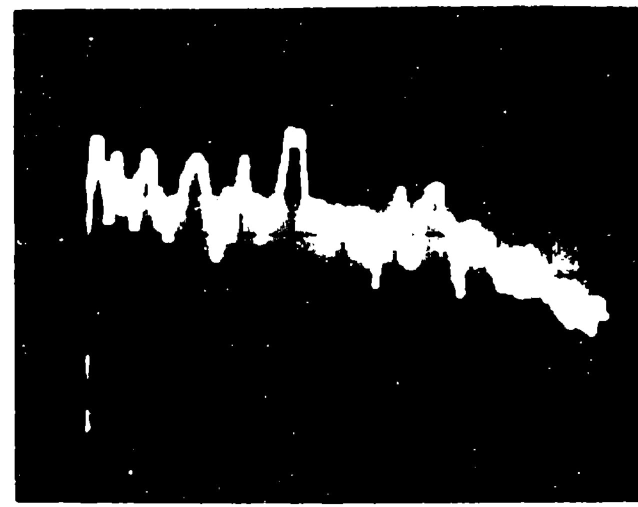

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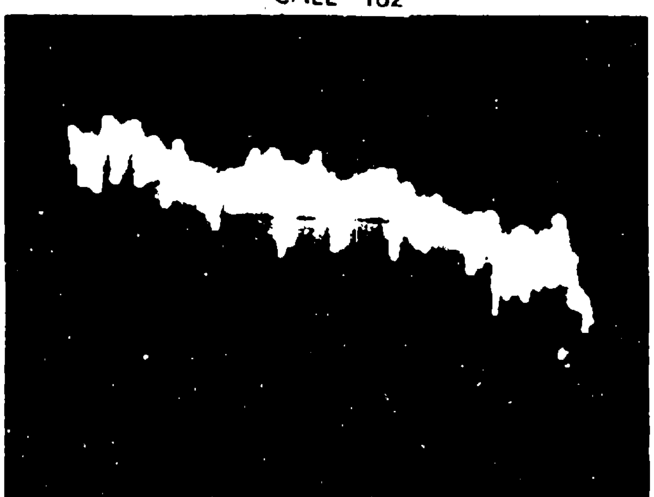

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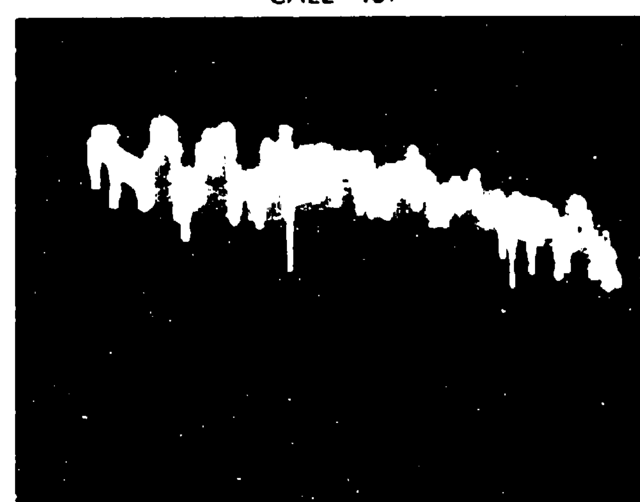

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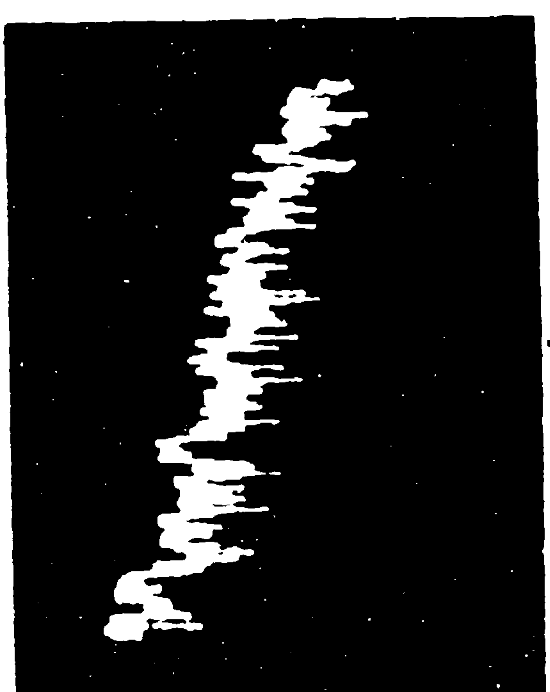

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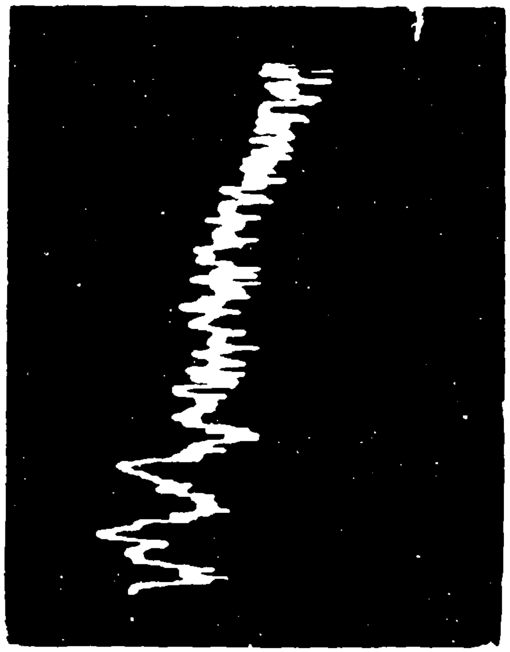
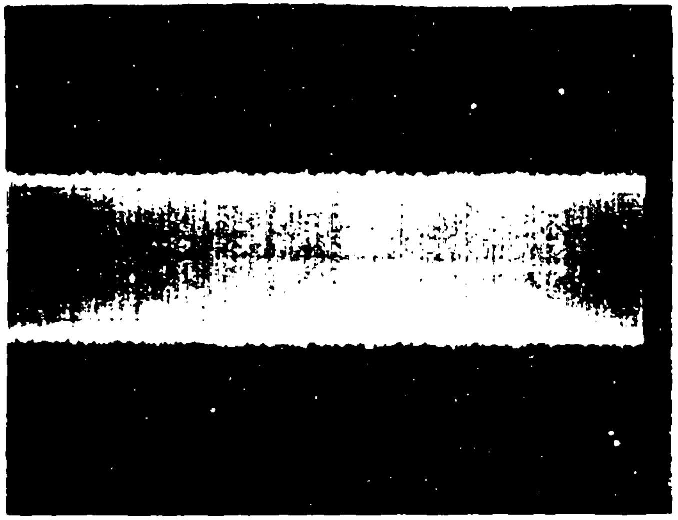


CALL #313

AMPLITUDE VARIATION PHOTOGRAPHS



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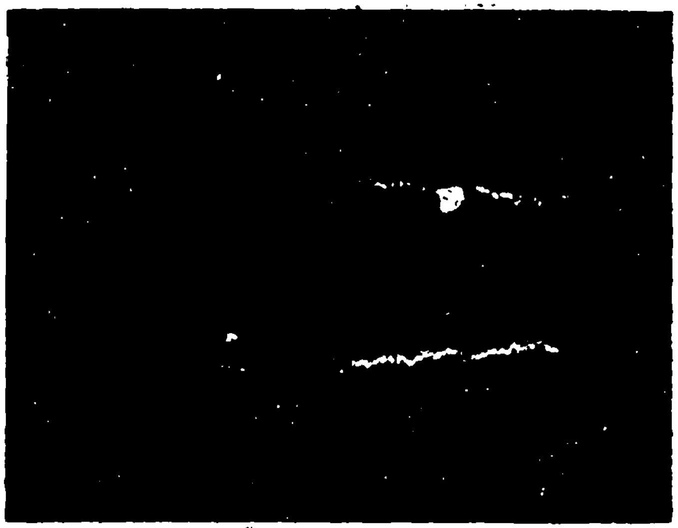

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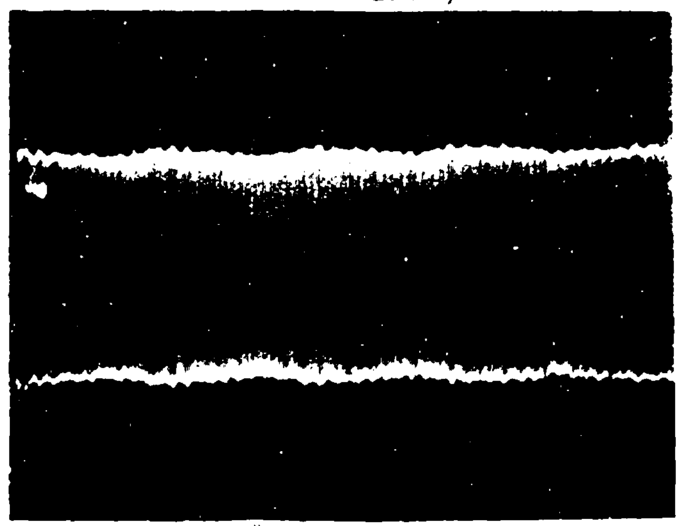

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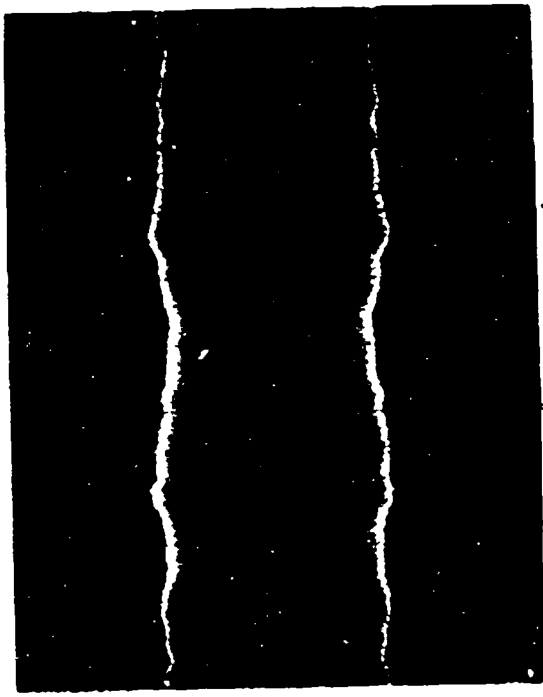

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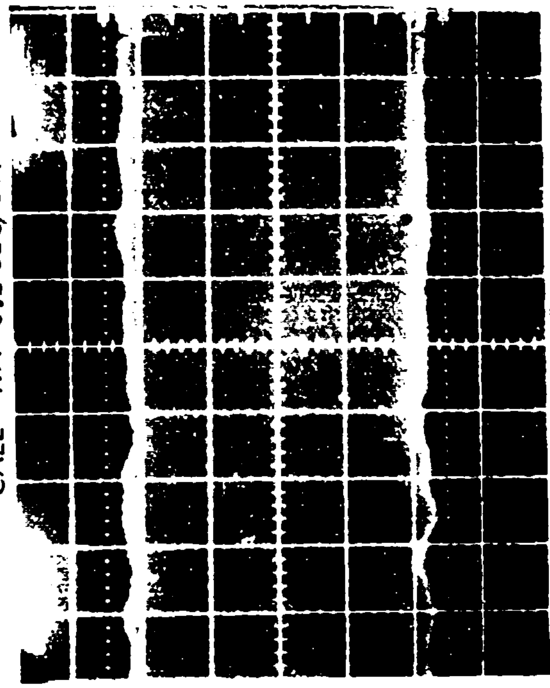

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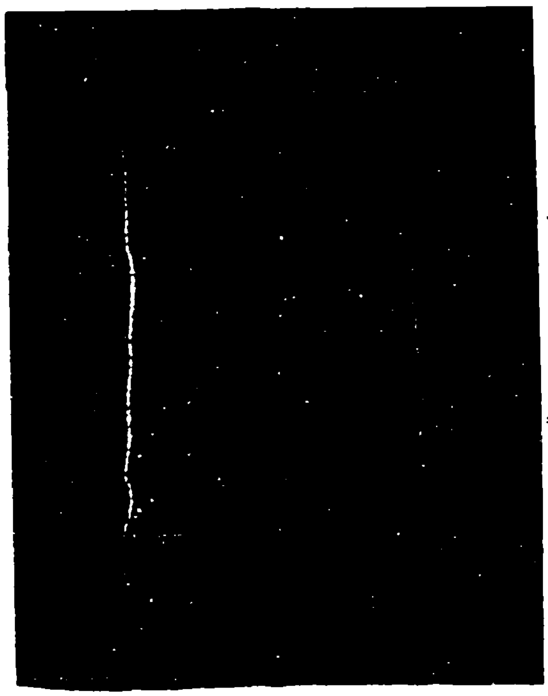

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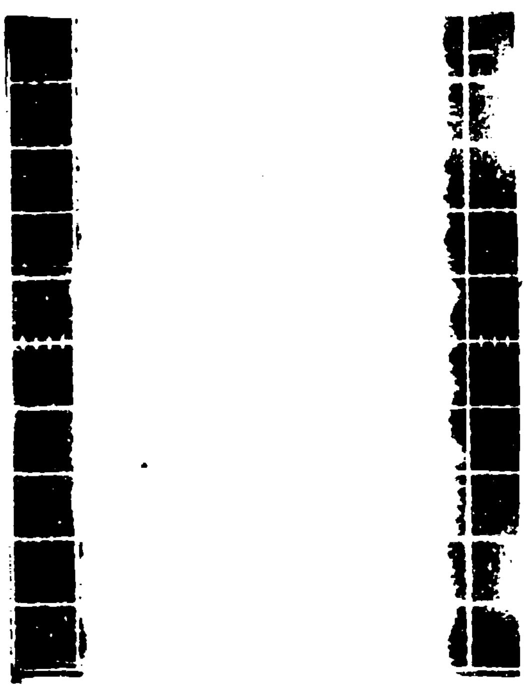
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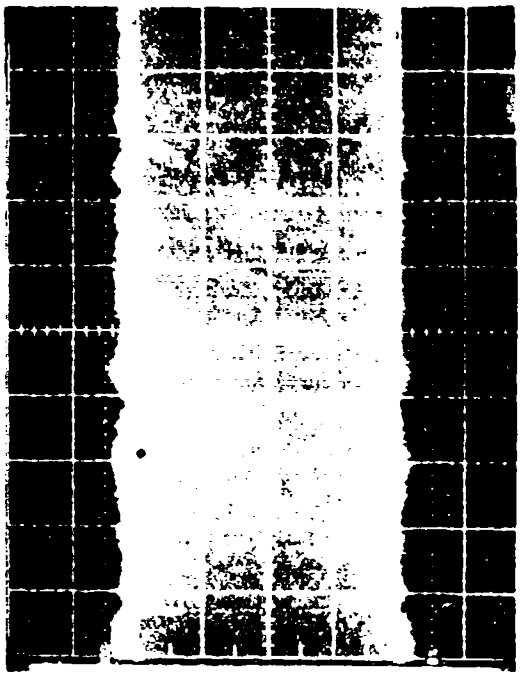
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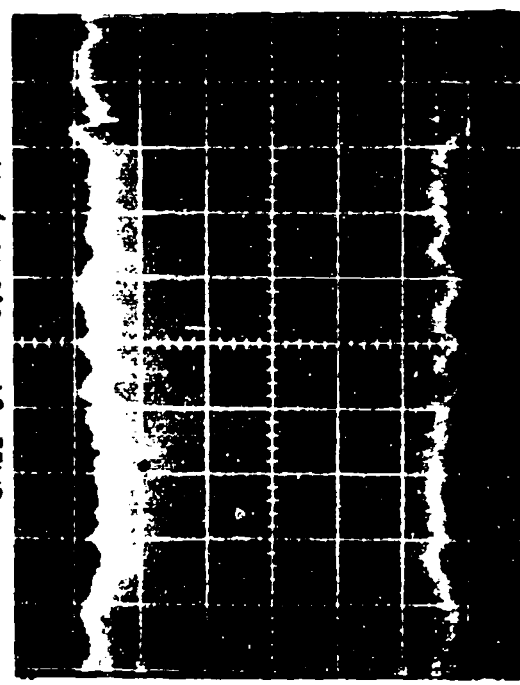
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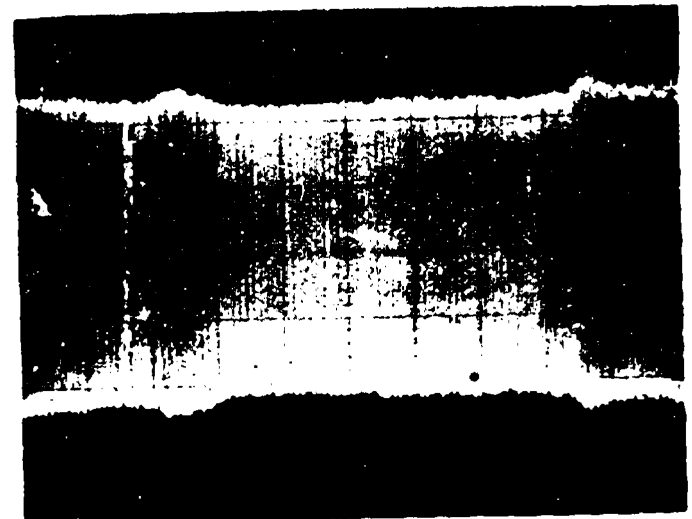

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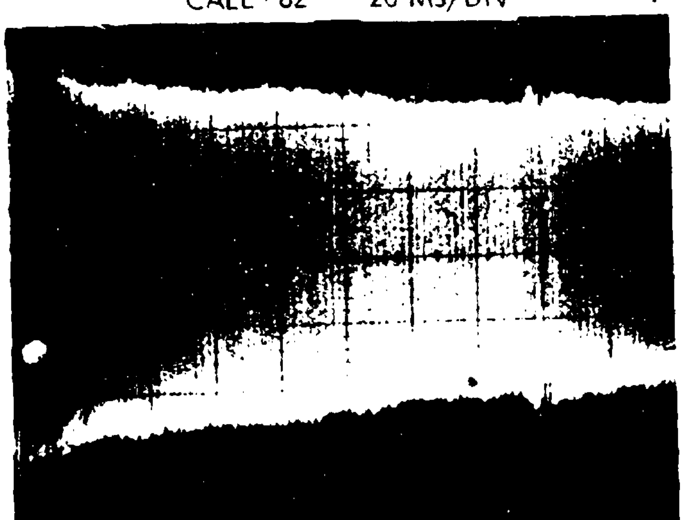

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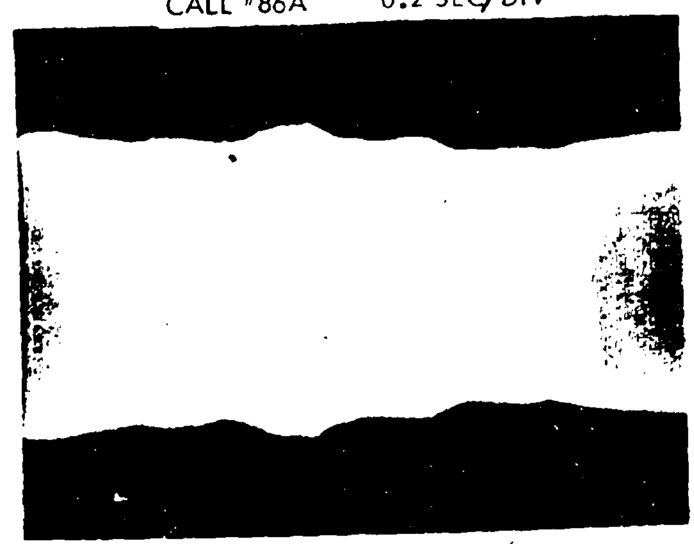

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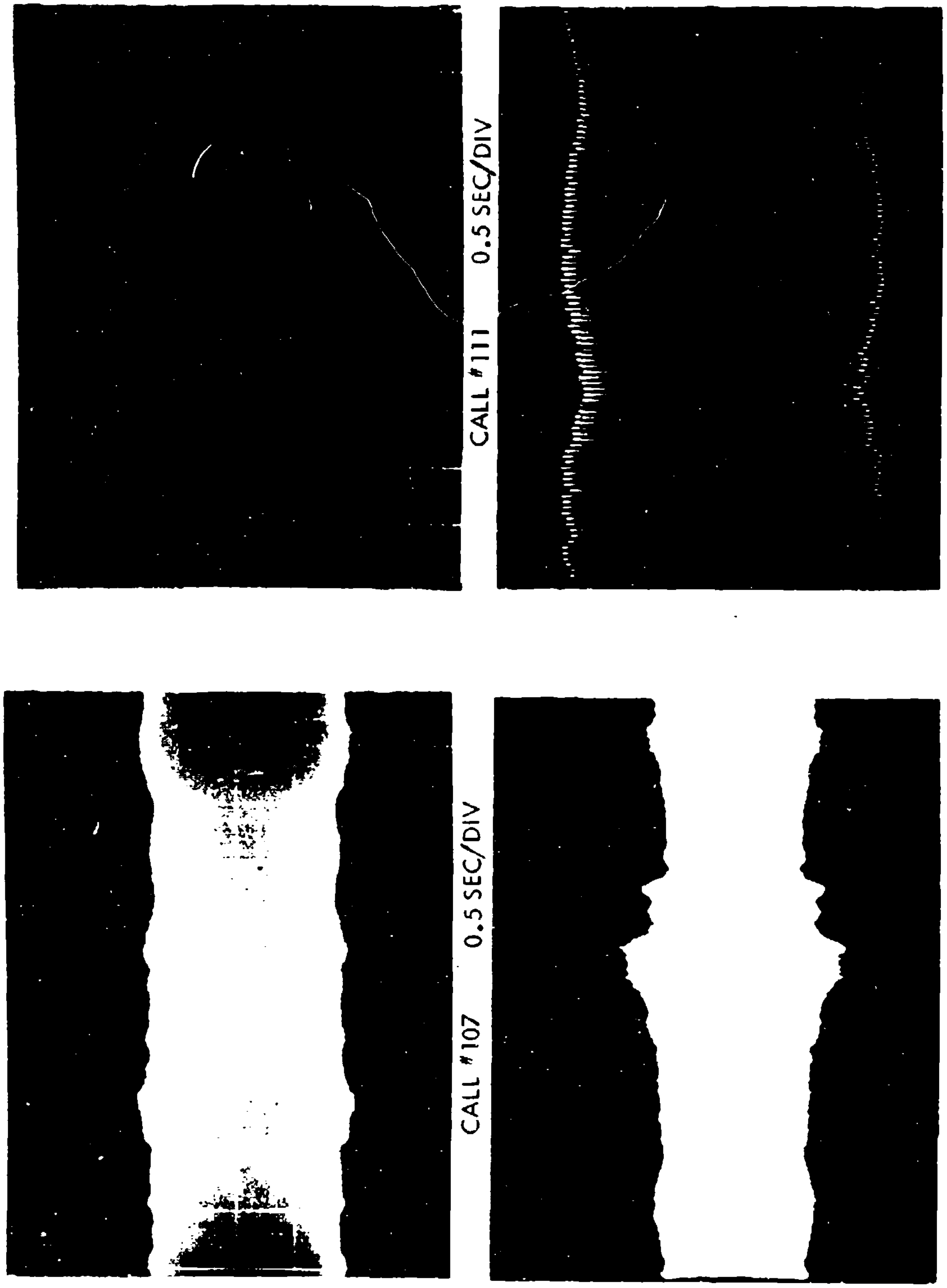

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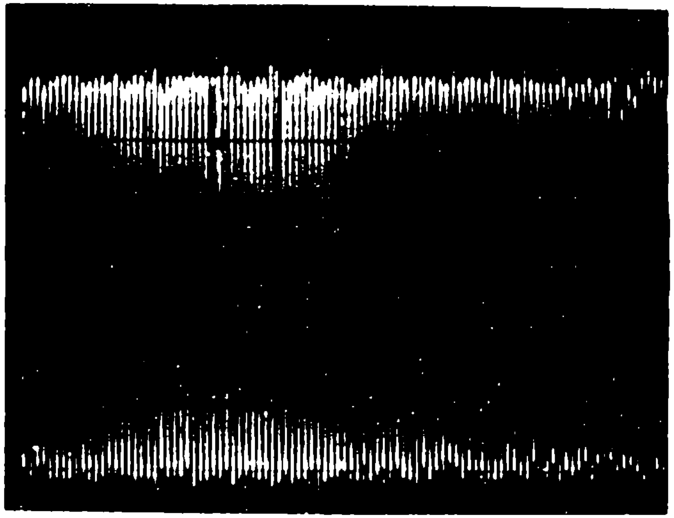

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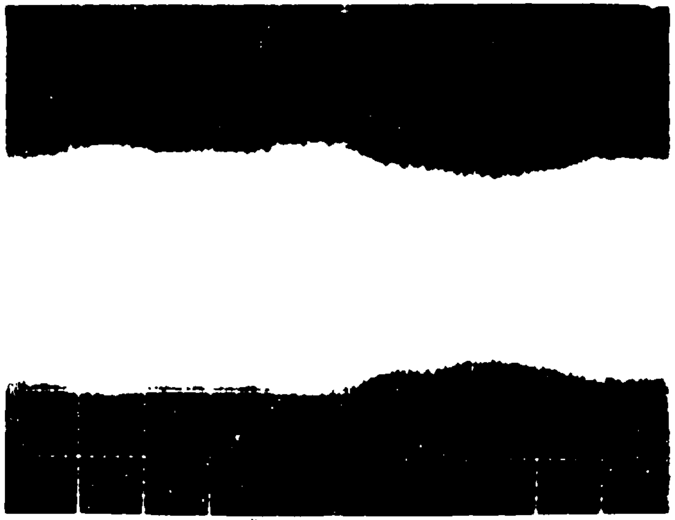

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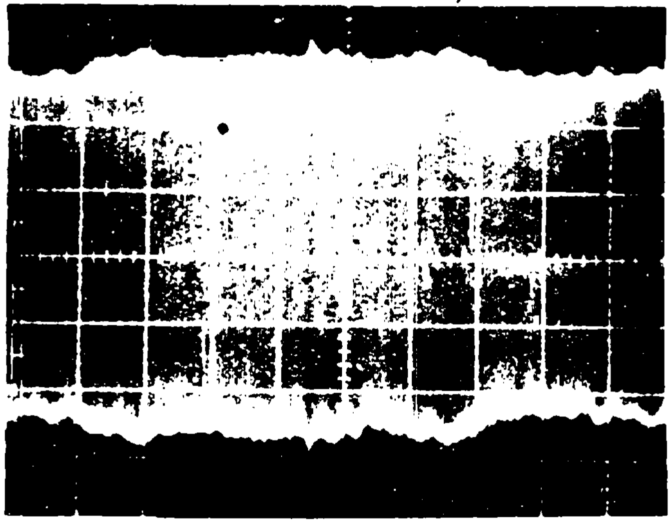

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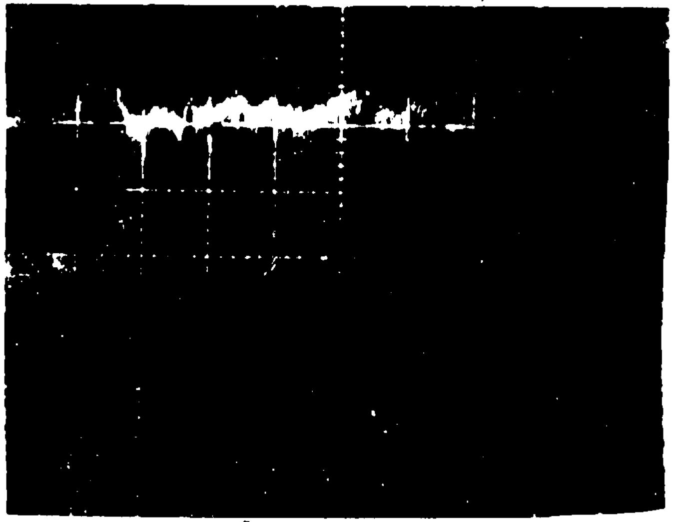

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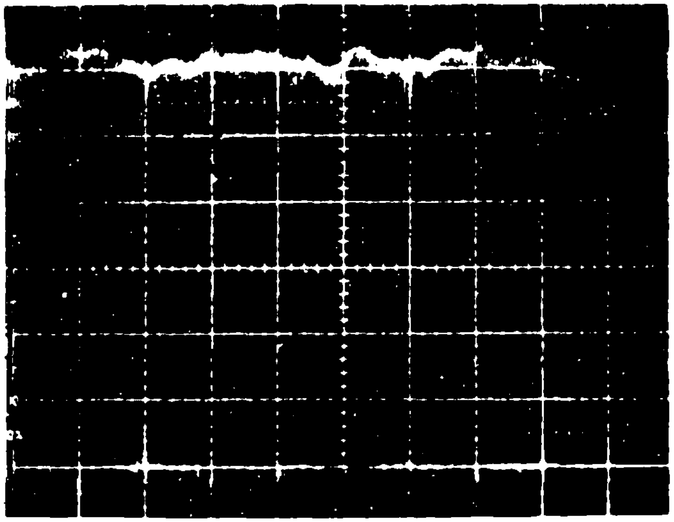

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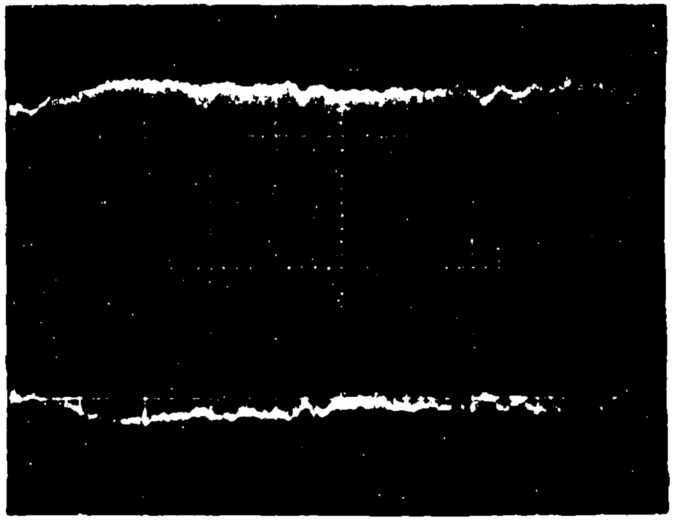

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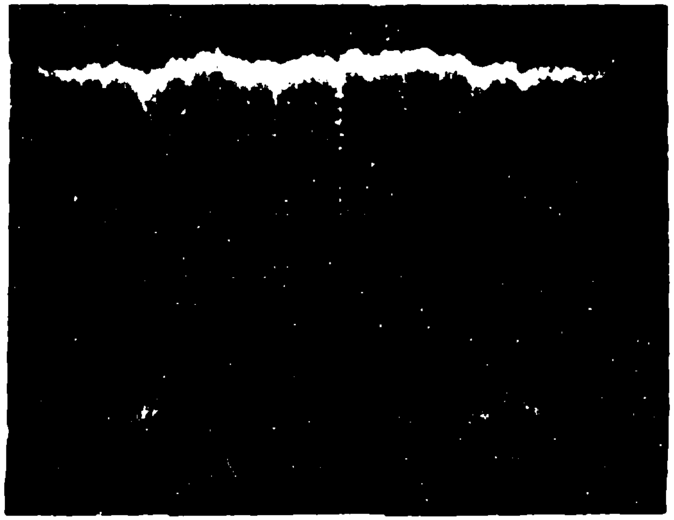

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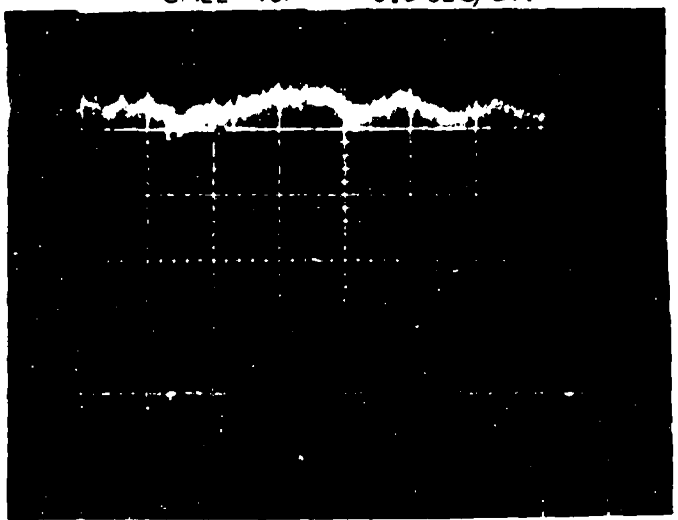

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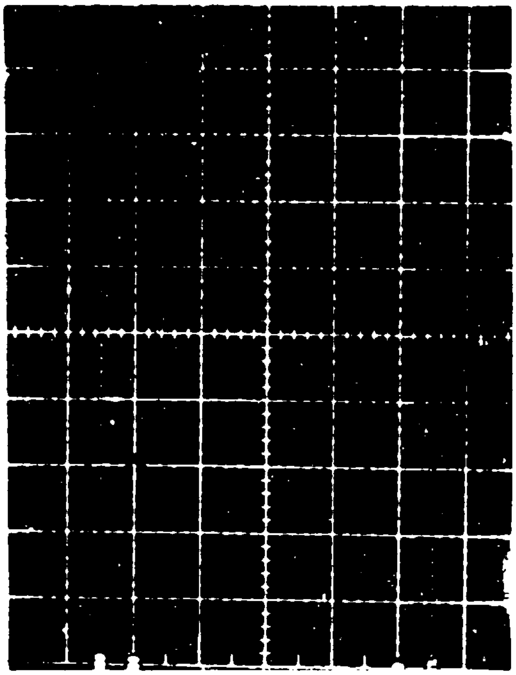

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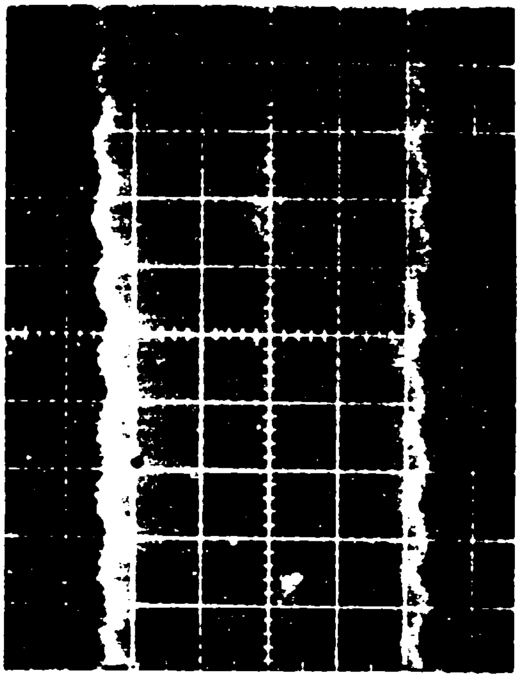

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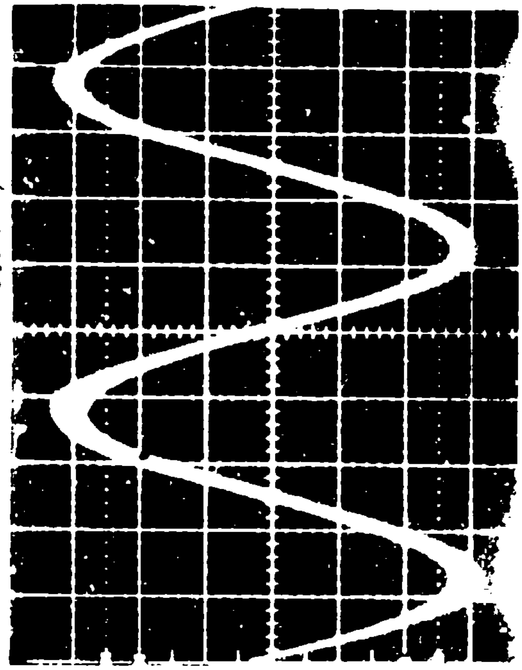

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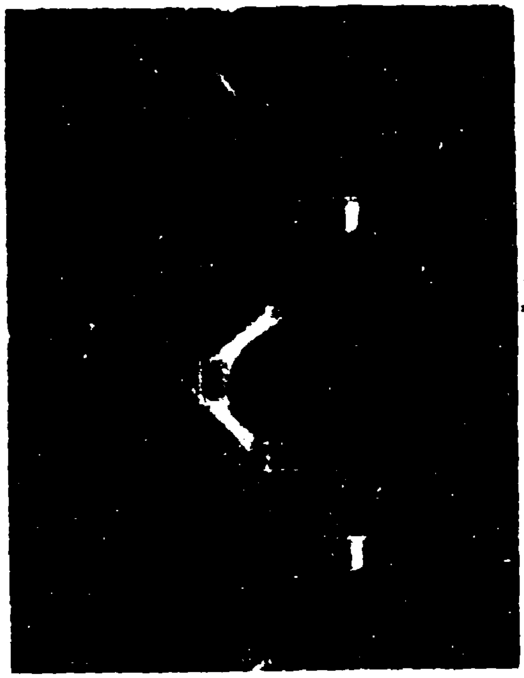

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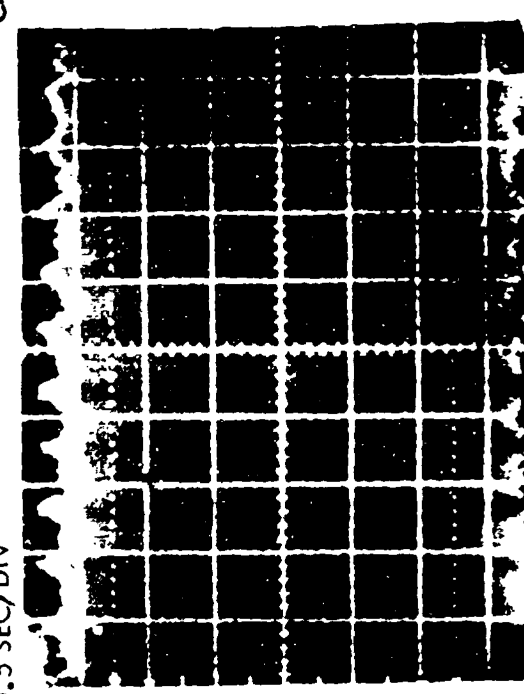


CALL #292 0.5 SEC/DIV

CALL #313 20 MS/DIV

Several unusual cases were also photographed:

a. Call number 181 exhibited a high frequency variation which is difficult to distinguish as additive or multiplicative.

b. Two cases of severe distortion were photographed (calls 240 and 297). These illustrate the time-variant waveforms on these calls, presumably caused by combinations of distortion and frequency offset.

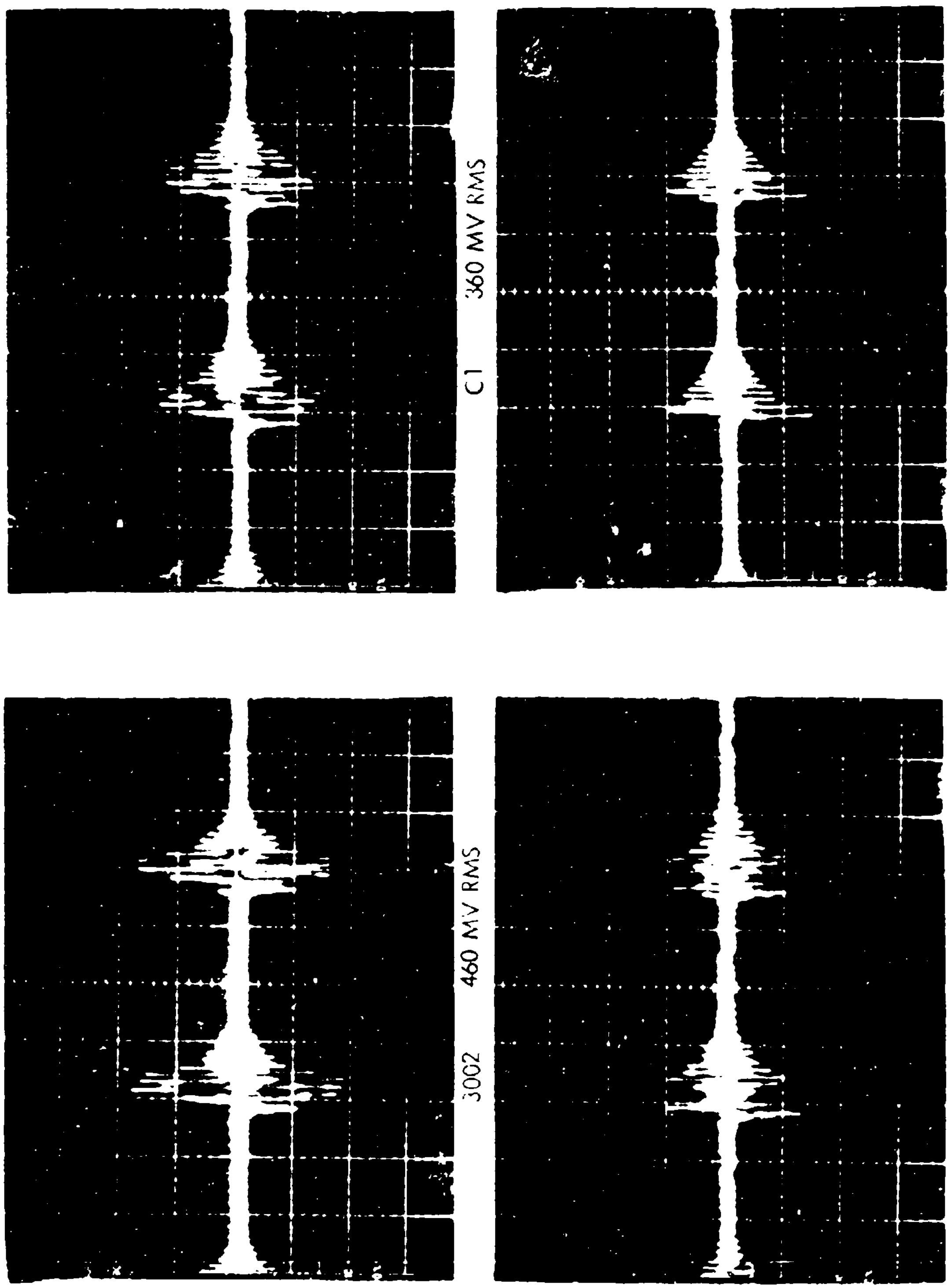
D-5 EQUALIZER WEIGHTS

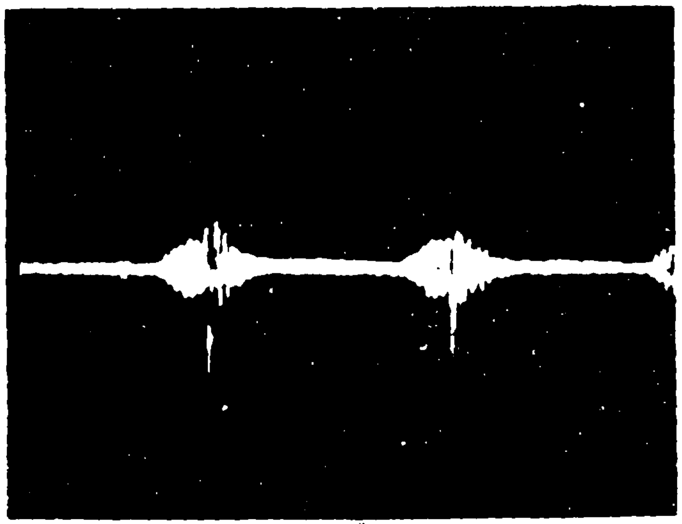
On some calls, photographs were taken of the analog version of the equalizer weights. The calls were usually selected as having unusual or interesting weight patterns. On these photos, the two weight patterns for sine and cosine demodulator outputs are shown. The 25 ms time span of the equalizer occupies 3.75 horizontal divisions on these photos.

For reference, the weight patterns generated by the four simulated lines (3002, C1, C2, C4) of the Axel line simulator are shown.

It was found difficult to assess the significance of the weight patterns, although calls like No. 225 are clearly harder to equalize than, say, call No. 170. Long weight patterns, such as call No. 188 are attributed to reflections due to poor terminations at some point in the circuit.

EQUALIZER WEIGHTS


C1 360 MV RMS
240 MV RMS
3002 460 MV RMS
250



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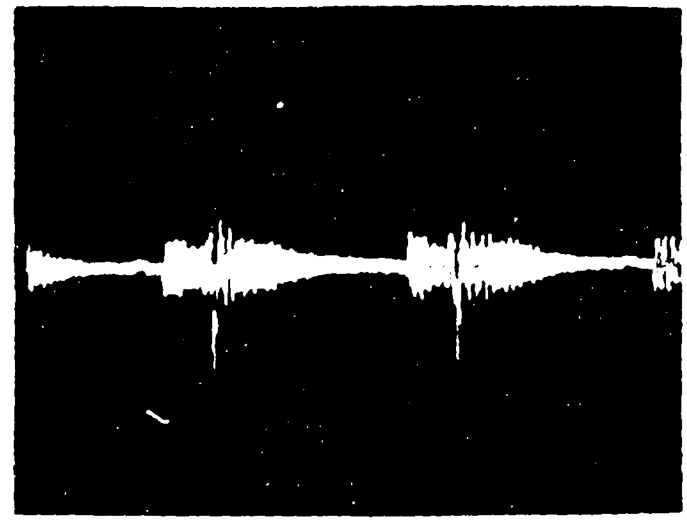

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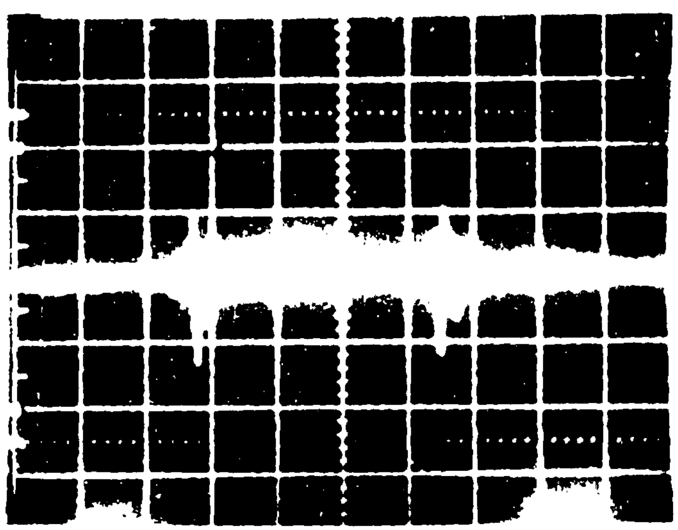

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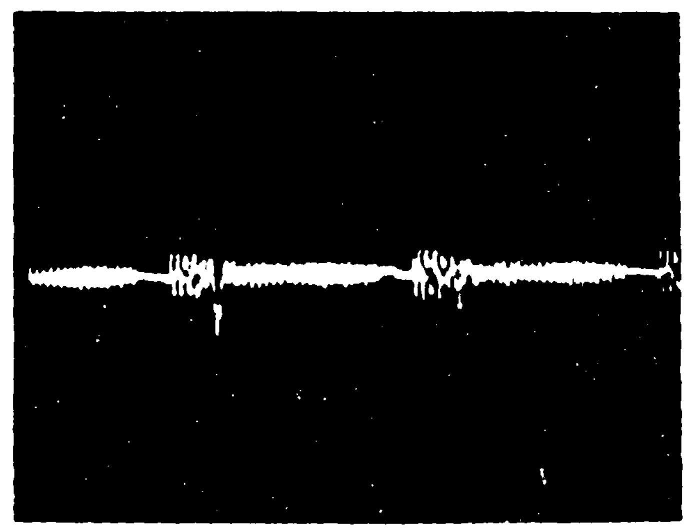

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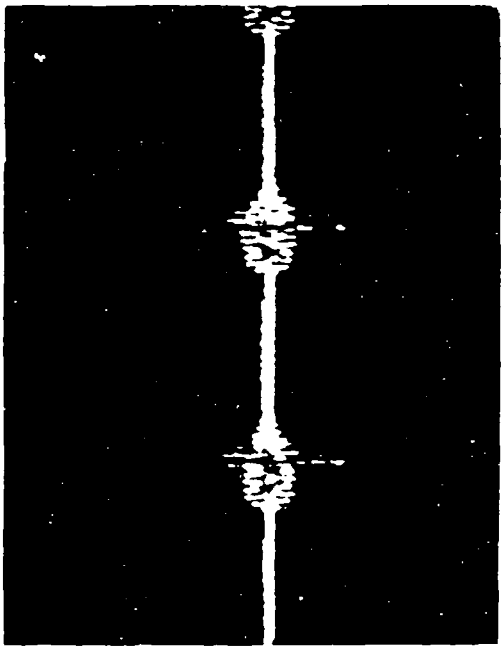

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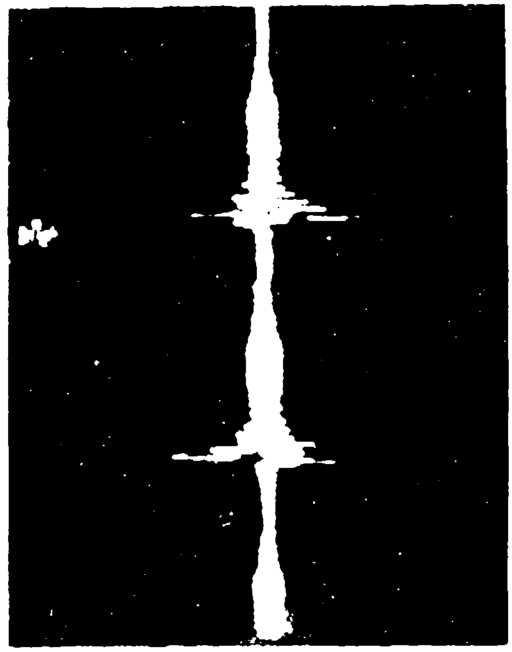

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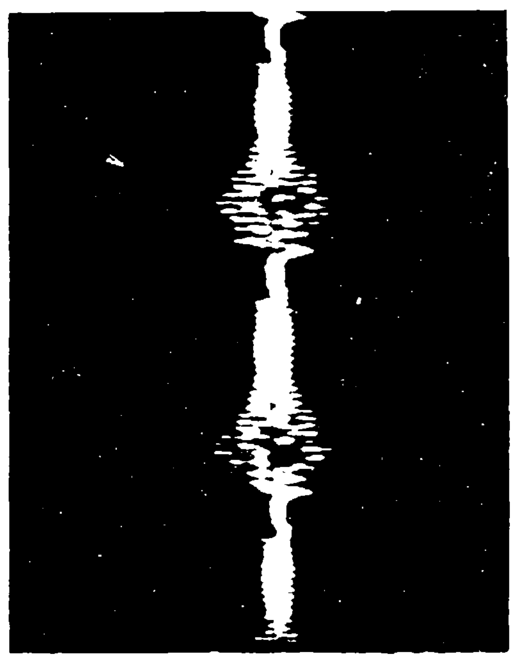

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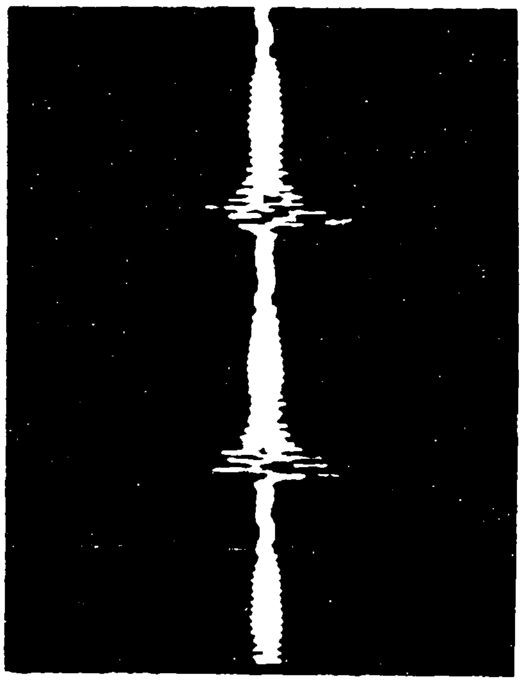

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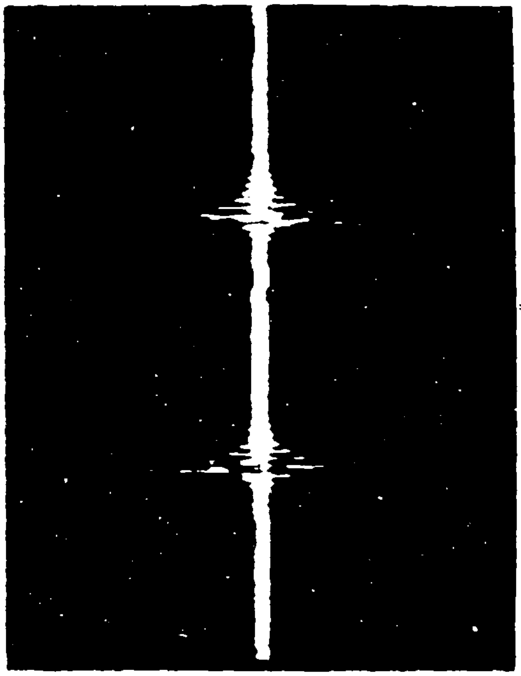

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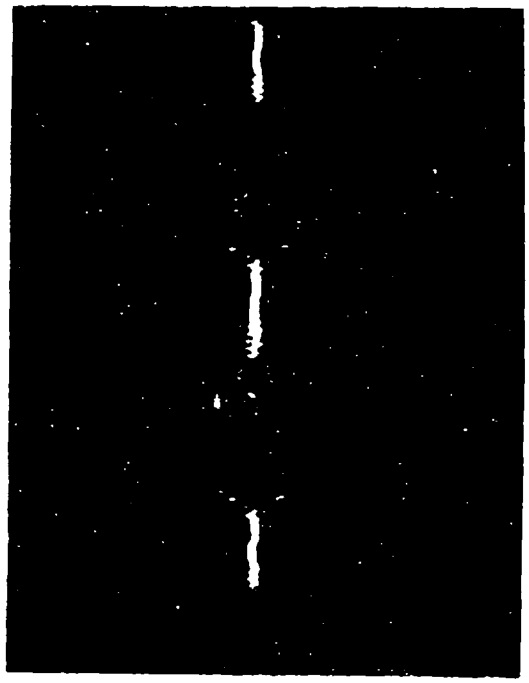

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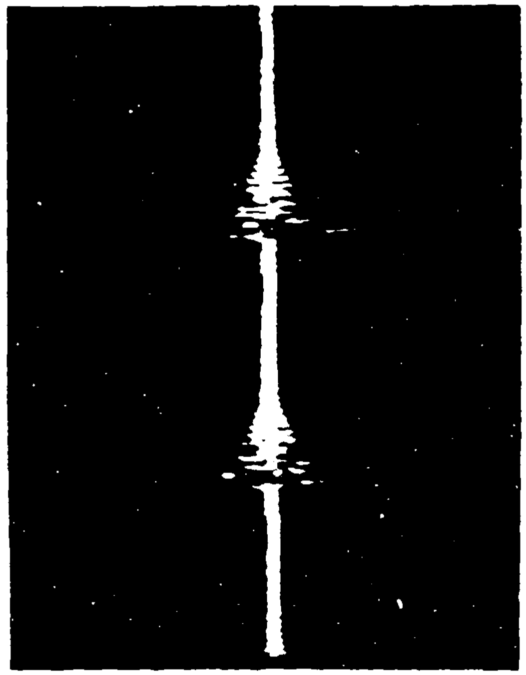

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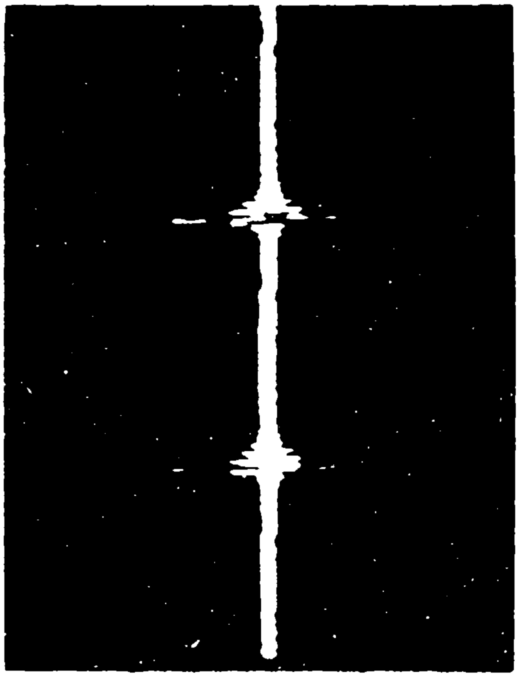

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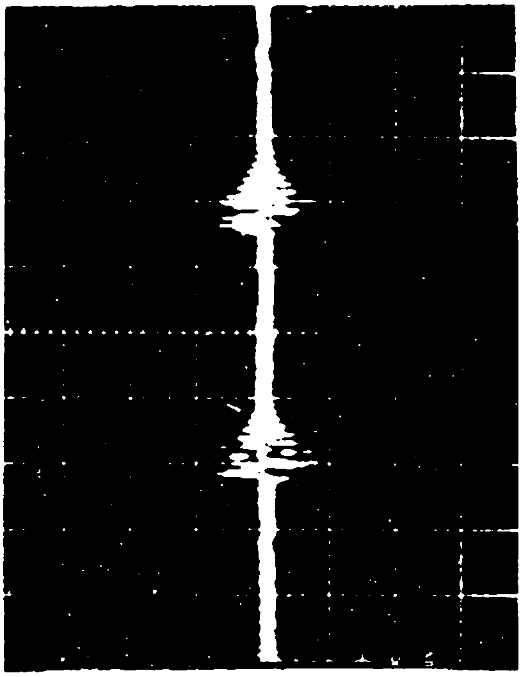

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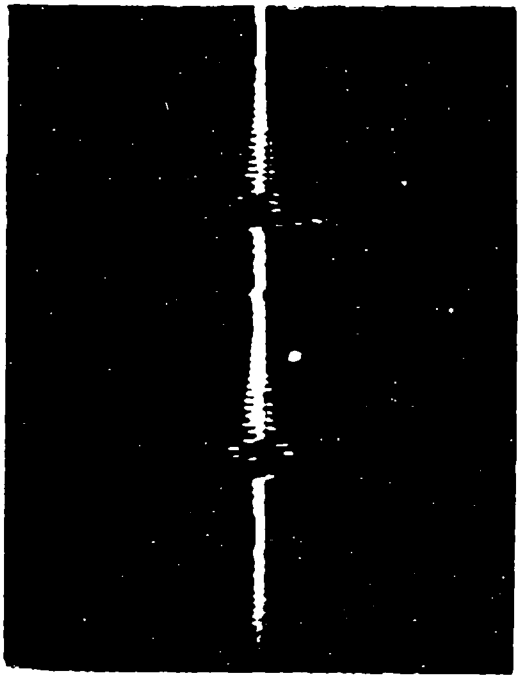

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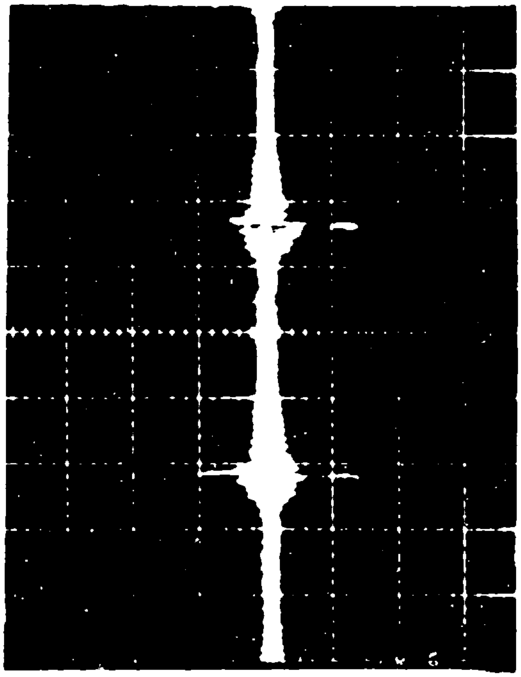

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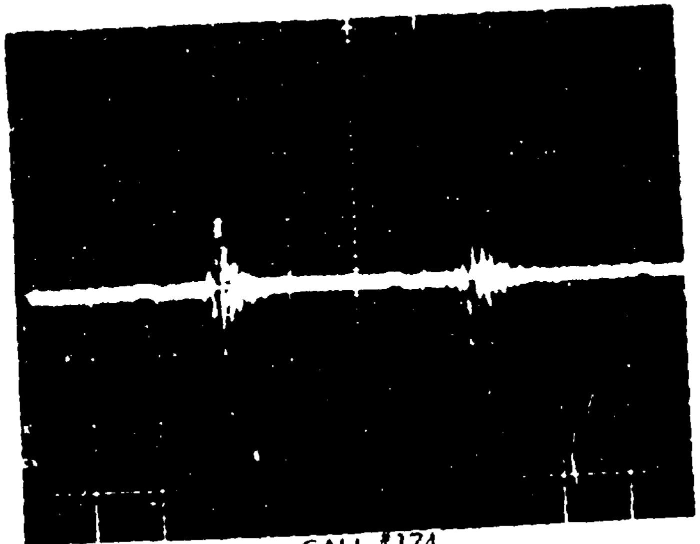

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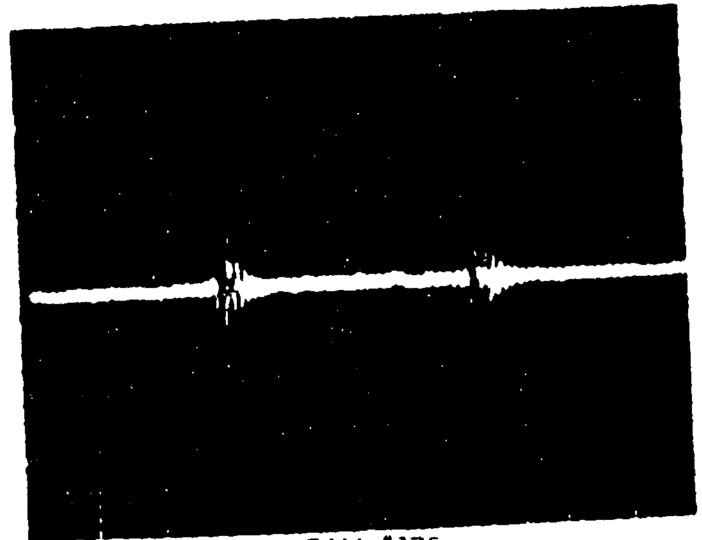

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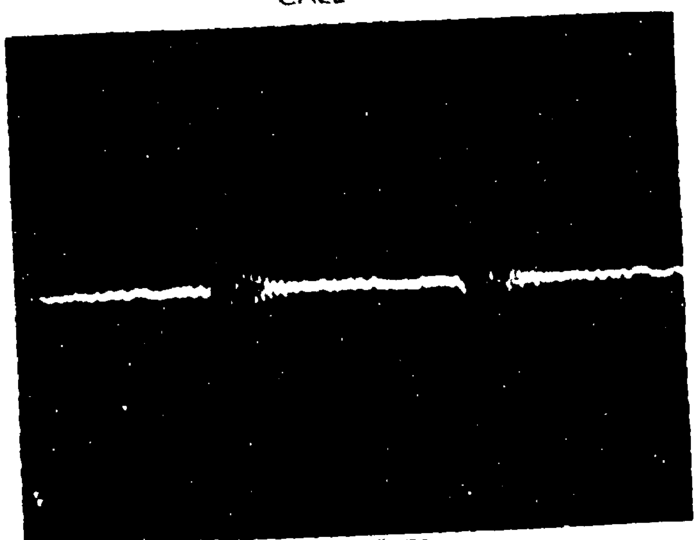

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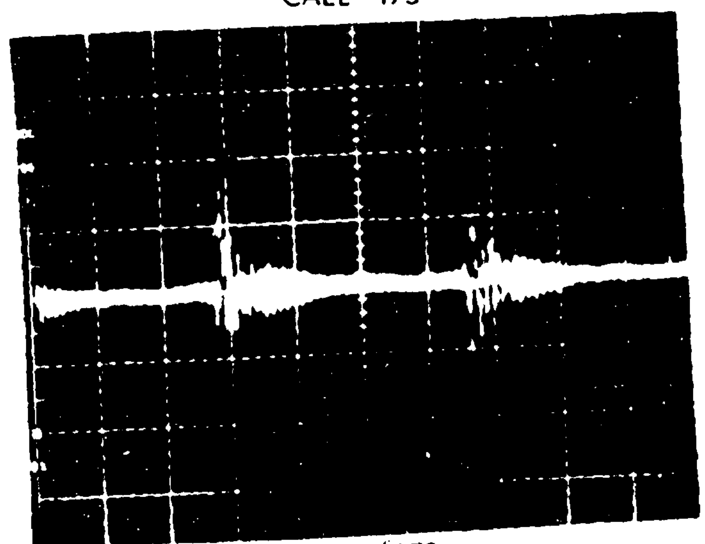

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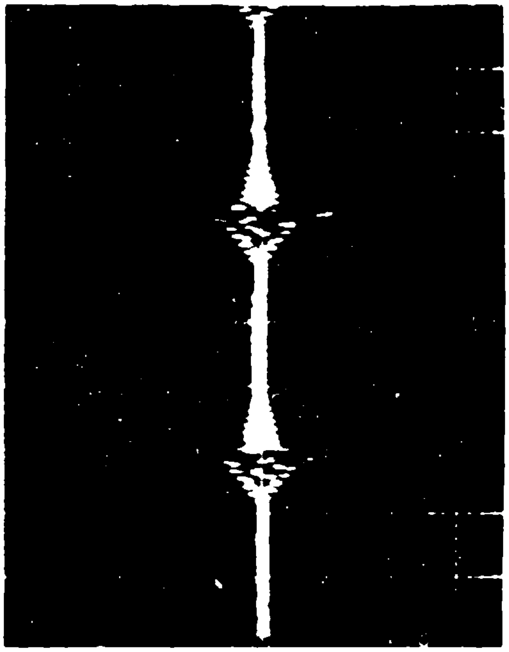

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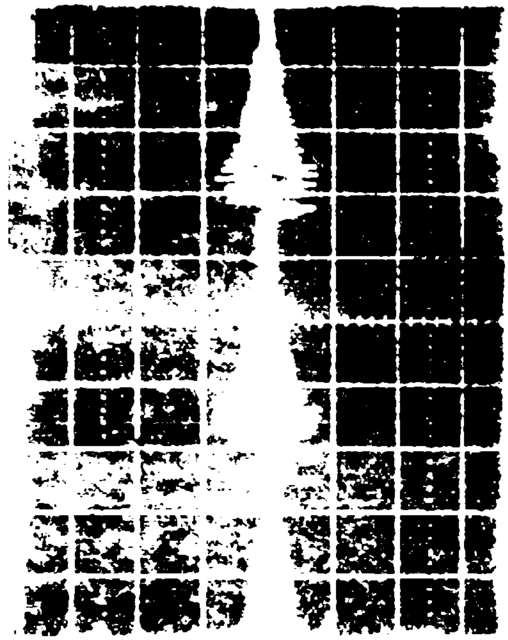

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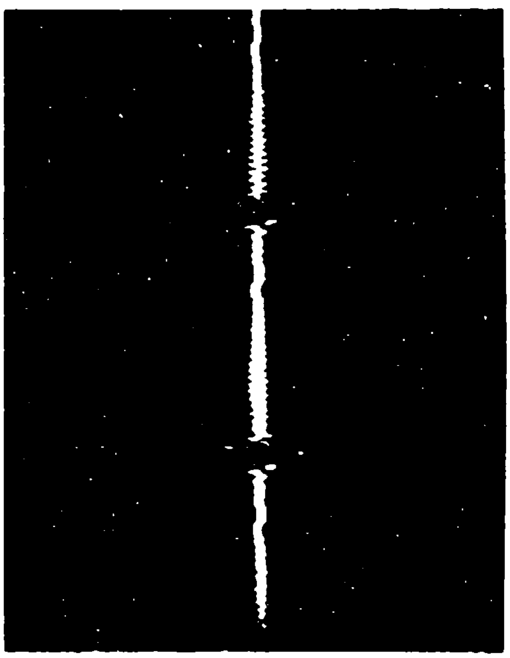

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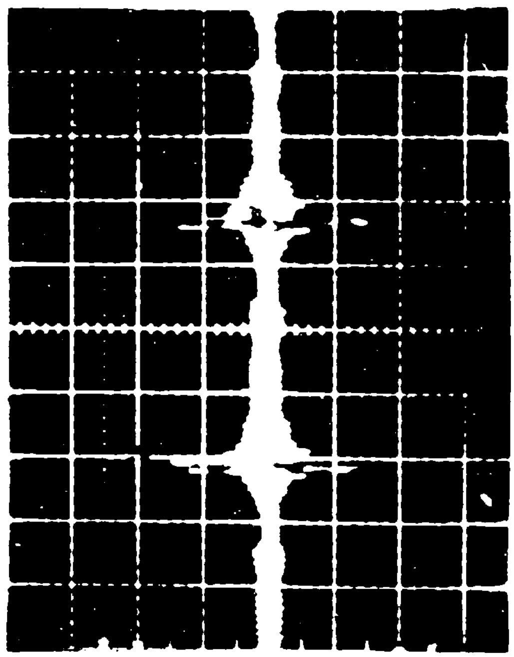

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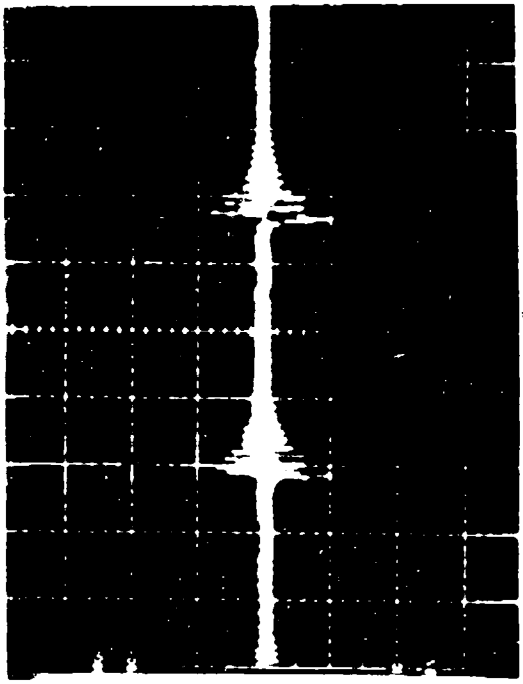

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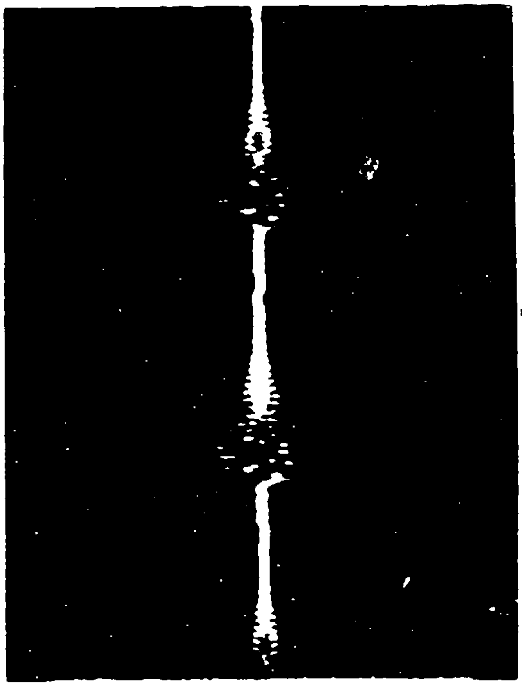

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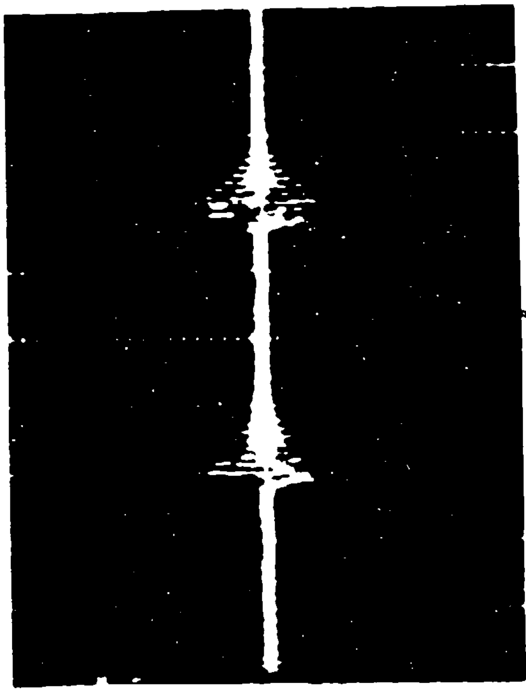

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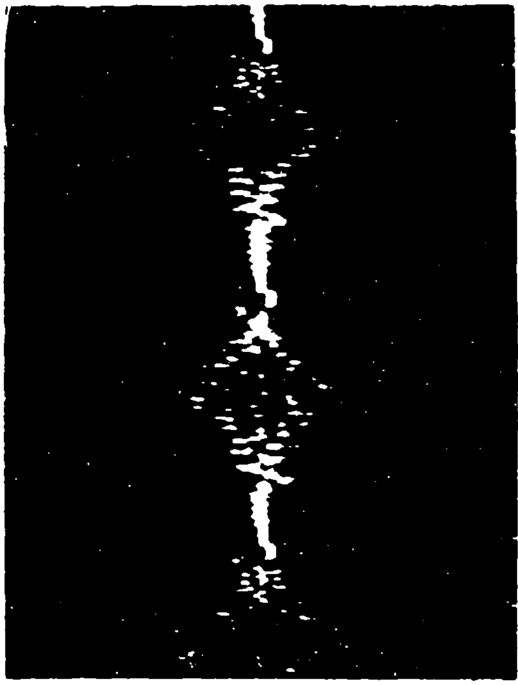

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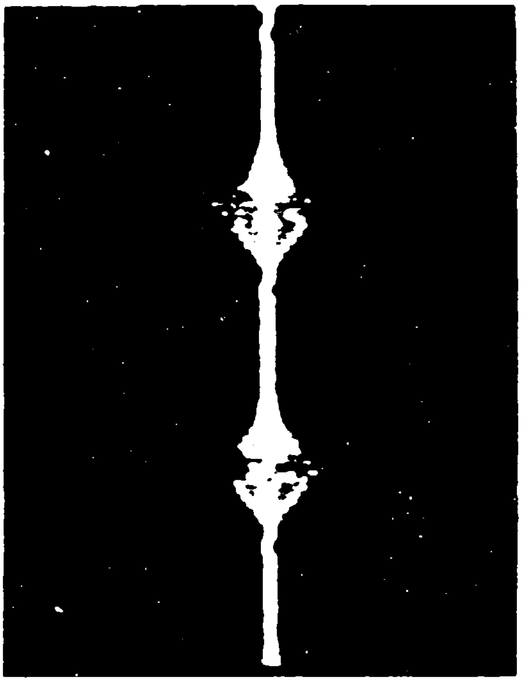

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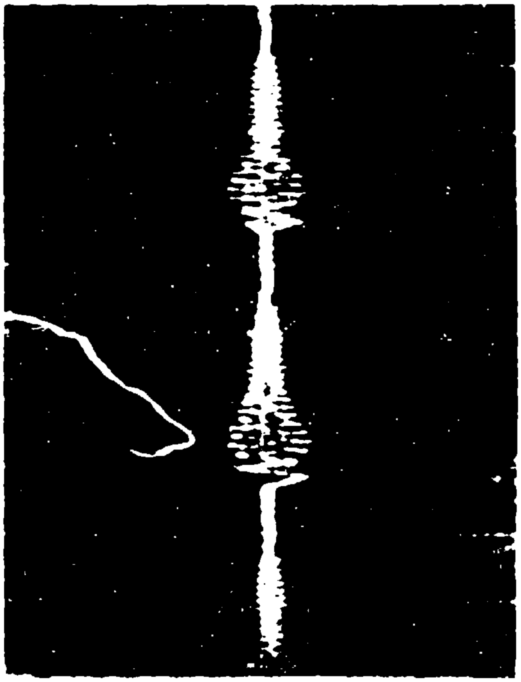

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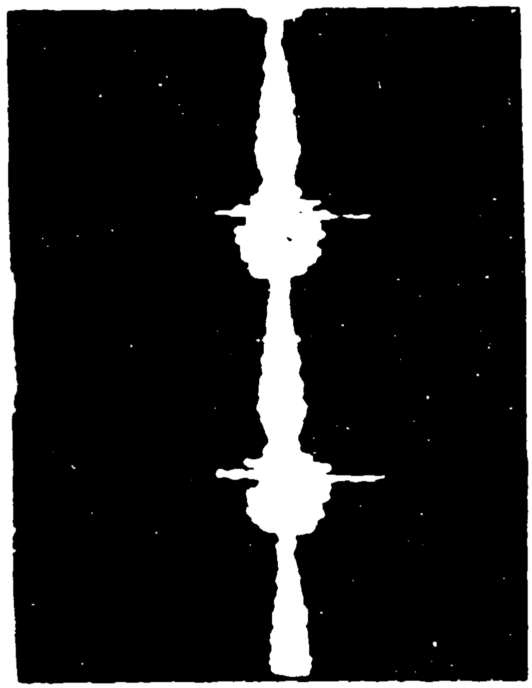

CALL #313

APPENDIX E

TEST SENTENCES

The following test sentences, from the 1965 revised list of phonetically balanced sentences from IEEE recommended practice for speech quality measurements,[12] were used during the test program. The particular list used for each call is given in the data tables of Appendix C.

List 1:

The birch canoe slid on the smooth planks.

Glue the sheet to the dark blue background.

It's easy to tell the depth of a well.

These days a chicken leg is a rare dish.

Rice is often served in round bowls.

The juice of lemons makes fine punch.

The box was thrown beside the parked truck.

The hogs were fed chopped corn and garbage.

Four hours of steady work faced us.

A large size in stockings is hard to sell.

List 2:

The boy was there when the sun rose.

A rod is used to catch pink salmon.

The source of the huge river is the clear spring.

Kick the ball straight and follow through.

Help the woman get back to her feet.

A pot of tea helps to pass the evening.

Smokey fires lack flame and heat.

The soft cushion broke the man's fall.

The salt breeze came across from the sea.

The girl at the booth sold 50 bonds.

List 3:

The small pup gnawed a hole in the sock.

The fish twisted and turned on the bent hook.

Press the pants and sew a button on the vest.

The swan dive was far short of perfect.

The beauty of the view stunned the young boy.

Two blue fish swam in the tank.

Her purse was full of useless trash.

The colt reared and threw the tall rider.

It snowed, rained and hailed the same morning.

Read verse out loud for pleasure.

List 4:

Hoist the load to your left shoulder.

Take the winding path to reach the lake.

Note closely the size of the gas tank.

Wipe the grease off his dirty face.

Mend the coat before you go out.

The wrist was badly strained and hung limp.

The stray cat gave birth to kittens.

The young girl gave no clear response.

The meal was cooked before the bell rang.

What joy there is in living.

List 5:

A king ruled the state in the early days.

The ship was torn apart on the sharp reef.

Sickness kept him home the third week.

The wide road shimmered in the hot sun.

The lazy cow lay in the cool grass.

Lift the square stone over the fence.

The rope will bind the 7 books at once.

Hop over the fence and plunge in.

The friendly gang left the drug store.

Mesh wire keeps chicks inside.

List 6:

The frosty air passed through the coat.

The crooked maze failed to fool the mouse.

Adding fast leads to wrong sums.

The show was a flop from the very start.

A saw is a tool used for making boards.

The wagon moved on we'l oiled wheels.

March the soldiers past the next hill.

A cup of sugar makes sweet fudge.

Place a rose bush near the porch steps.

Both lost their lives in the raging storm.

List 7:

We talked of the side show in the circus.

Use a pencil to write the first draft.

He ran halfway to the hardware store.

The clock struck to mark the third period.

A small creek cut across the field.

Cars and busses stalled in the snow drift.

The set of china hit the floor with a crash.

This is a grand season for hikes on the road.

The dune rose from the edge of the water.

Those words were the cue for the actor to leave.

List 8:

A yacht slid around the point into the bay.

The two met while playing on the sand.

The ink stain dried on the finished page.

The walled town was seized without a fight.

The lease ran out in 16 weeks.

A tame squirrel makes a nice pet.

The horn of the car woke the sleeping cop.

The heart beats strongly and with firm strokes.

The pearl was worn in a thin silver ring.

The fruit peel was cut in thick slices.

List 9:

The Navy attacked the big task force.

See the cat glaring at the scared mouse.

There are more than two factors here.

The hat brim was wide and too droopy.

The lawyer tried to lose his case.

The grass curled around the fence post.

Cut the pie into large parts.

Men strive but seldom get rich.

Always close the barn door tight.

He lay prone and hardly moved a limb.

List 10:

The slush lay deep along the street.

A wisp of cloud hung in the blue air.

A pound of sugar costs more than eggs.

The fin was sharp and cut the clear water.

The play seemed dull and quite stupid.

Bail the boat; stop it from sinking.

The term ended in late June that year.

A tusk was used to make costly gifts.

Ten pins were set in order.

The bill was paid every third week.

BIBLIOGRAPHY

1. "16 kb/s Data Modem," RADC-TR-76-311, 14 June 1976, Rome Air Development Center, DCLD, Griffiss Air Force Base, N.Y. 13441, AD B015 627L.

2. "European Autovon Channel Study," RADC-TR-72-70, March 1972, Rome Air Development Center, Griffiss Air Force Base, N.Y. 13441, AD 894 903L.

3. "DCS Multiplex Configuration," Drawing No. EUR-COM-COS-007, 2 March 1976, Headquarters European Area, Defense Communications Agency, APO, New York 09131.

4. "Autovon Access Line Record," Project E06, Sort Fields 230117, 9 Sept. 1976, Headquarters European Area, Defense Communications Agency, APO, New York 09131.

5. "CONUS Autovon Routing Philosophy," DCA Circular 370-V120-1, Dec. 1966, Defense Communications Agency, Washington, D.C. 20305.

6. "Overseas Autovon Network Switching Plans," DCA Circular 370-V185-7; October 1967, Defense Communications Agency, Washington, D.C. 20305.

7. "Circuit and Trunk File Data Elements and Coder Manual of the Defense Communications System (DCS)," DCA Circular 310-65-1, June 1976, Defense Communications Agency, Washington, D.C. 20305.

8. "Leased Overseas Circuits and CONUS Extension Report," (DECCO(M) 650-9, 31 Oct. 1976, Pacific Area, Defense Communications Agency, APO 96515 San Francisco, Cal.

9. "NCS Transoceanic Circuits," NCS 0070,370-026, 17 Nov. 1976, Pacific Area, Defense Communications Agency, APO 96515, San Francisco, Cal.

10. "The World's Submarine Telephone Cable Systems," Department of Commerce, August 1975, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

11. DCA Pacific Circuit/MUX Diagrams dated 1 July 1976.

12. 1965 Revised List of Phonetically Balanced Sentences from IEEE Recommended Practice for Speech Quality Measurements.

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RADC plans and conducts research, exploratory and advanced development programs in command, control, and communications (C^3) activities, and in the C^3 areas of information sciences and intelligence. The principal technical mission areas are communications, electromagnetic guidance and control, surveillance of ground and aerospace objects, intelligence data collection and handling, information system technology, ionospheric propagation, solid state sciences, microwave physics and electronic reliability, maintainability and compatibility.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

DEPARTMENT OF THE AIR FORCE
AIR FORCE RESEARCH LABORATORY (AFMC)

1 Jun 04

MEMORANDUM FOR DTIC-OCQ
ATTN: Larry Downing
Ft. Belvoir, VA 22060-6218

FROM: AFRL/IFOIP

SUBJECT: Distribution Statement Change

1. The following documents have been reviewed and have been approved for Public Release; Distribution Unlimited:

ADB084552, "Project Birdwatch at Dover AFB", RADC-TR-84-7

ADB191869, "Acousto-Optic Beam Steering Study", RL-TR-94-121

AD0800669, "Use of Commercial Broadcast Facilities for Emergency DoD Communications", RADC-TR-66-392

ADB058979, "Multi-Rate Secure Processor Terminal Architecture Study", RADC-TR-81-77, Vol 1.

ADB053656, "16 KB/S Modem (AN/GCS-38) CONUS Test", RADC-TR-80-89

ADB055136, "VINSON/AUTOVON Interface Applique for the Modem, Digital Data, AN/GCS-8", RADC-TR-80-341

ADB043556, "16 KB/S Data Modem Partitioning", RADC-TR-79-278

ADB029131, "16 Kilobit Modem Evaluation", RADC-TR-78-127.

2. Please contact the undersigned should you have any questions regarding this document. Thank you very much for your time and attention to this matter.

Kelly Cagwin

KELLY CAGWIN
STINFO Officer
Information Directorate
315-330-7094/DSN 587-7094